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DE FOREST WIRELESS TELEGRAPH ON THE STEAM YACHT ERIN.

The developments of wireless telegraphy, which have taken place in such rapid succession, have opened up an entirely new industry in the electrical field. It was only a very few years ago that Marconi published his first successful experiments in transmitting wireless

of the Herzian waves, such as the penetrability of mountains of the earth by this wave, have been exploded, and it is proved that the irregularities of the surface of the earth do offer resistance to the progress of this wave.

The greatest successes of any of the systems of wire-



STEAM YACHT ERIN, EQUIPPED WITH THE DE FOREST WIRELESS TELEGRAPH.

[Photograph by E. Muller.]

telegraph messages, and to-day wireless systems of telegraphy are being commercially installed and used to a constantly increasing extent, and wireless telephony, which is now the subject of general experiment, may be expected to soon appear commercially.

It is for marine purposes, however, that these two systems are most eminently suited. Many former beliefs and theories as to the qualities and characteristics

less telegraphy have been attained at sea, and it is now generally believed that the wave front is perpendicular to its path and that it may be bent or distorted by geographical obstructions. It will, however, travel around the surface of the earth, regardless of the earth's curvature, for messages are constantly being sent or received between two points which are below the horizon from each other.

Many of the transatlantic steamships are already equipped with the wireless telegraphy for communicating with each other and for sending messages ashore, but several of the installations have not as yet proved as successful as anticipated.

Before Sir Thomas Lipton sailed with his little fleet

mate, *Shamrock I.*, and her consorts have made lower New York bay and the region behind Sandy Hook their mooring grounds, while by means of the wireless equipment Sir Thomas has at all times been in communication with the shore. Also, progress of the trial races between the two *Shamrocks* has been reported to the

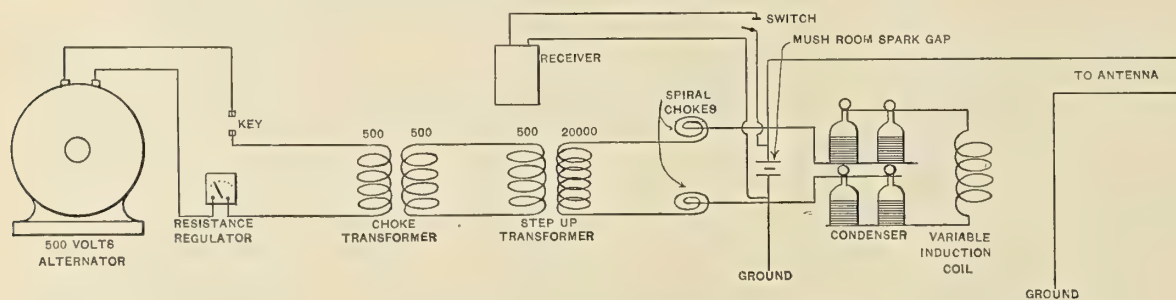


DE FOREST WIRELESS TELEGRAPH APPARATUS ON THE STEAM YACHT ERIN.

The Condenser is shown at the left hand with wires leading up to the mast, and the Responder or receiver is directly above the box at the right.

from Scotland to lift the *America's* cup, he had installed on his steam yacht *Erin* the De Forest system of wire-

Associated Press by tis representative on board the *Erin*.



WIRING PLAN OF THE DE FOREST SYSTEM.

Marine Engineering

less telegraphy. At the time of sailing there were no such stations on the other side, but several had been established along our coast, and it was for the purpose of communicating with land at this end of his voyage that this system was adopted. It will be remembered that when over a hundred miles from shore the operator at the De Forest station at Coney Island picked up, as it is termed, the *Erin*, and from that time on to her arrival in port was in constant communication with her. Since then the cup challenger *Shamrock III.*, her racing

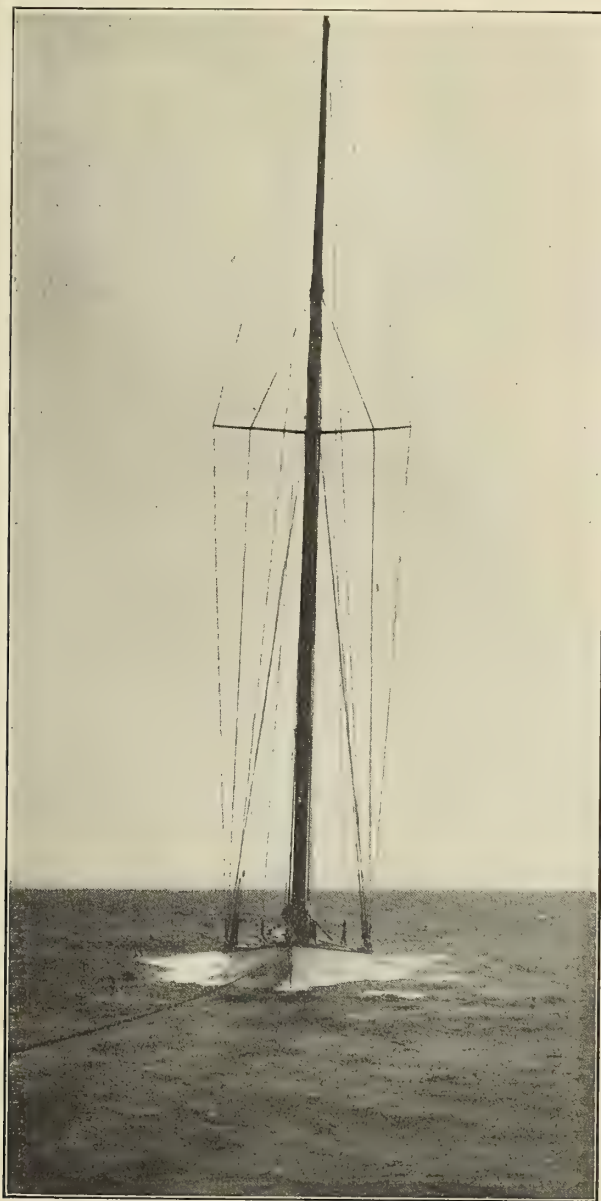
For the uninitiated to witness the transmission of a wireless message, it is indeed remarkable and hard to comprehend, yet to hear the receipt of a message is still more marvelous. In this system the messages are detected by an ordinary telephone receiver, and the waves emanating from the sending station, being caught and reproduced by the receiving wires and mechanism, are, as it were, heard faintly in the earpiece.

A special house was built on the *Erin* directly aft the mainmast, on top of the deck house, for receiving the

equipment, and through the roof extend the wires to the long antenna which is supported by a special gaff fitted at top of the mainmast.

The layout of this installation is shown in the diagram on page 446. A small motor-driven alternator supplies current at 500 volts. This passes through a choke transformer or lightning arrester, and thence to a step-up static transformer which raises it to about 20,000

nected as shown in the diagram, is thrown in by the switch. Here is the most fundamental difference between Marconi and all other systems of wireless telegraphy, in that no coherer is required. In its place is a little instrument called the responder, which serves the same purpose. The coherer, it will be remembered, consists of a tube filled with iron filings, through which the circuit from the antenna passes for the purpose of



SHAMROCK III. IN TOW.

[Photographed specially for Marine Engineering by E. Muller.]

volts tension. From here the wires lead through small spiral chokes to the condenser, which is made up of two sets of Leyden jars with a mushroom sparking gap and a variable induction coil. From one pole of the sparker connection is made to the antenna and the other leads to the ground. The return line from the antenna leads to the ground, and thus the transmitting circuit is completed.

For receiving messages, the receiver, which is con-

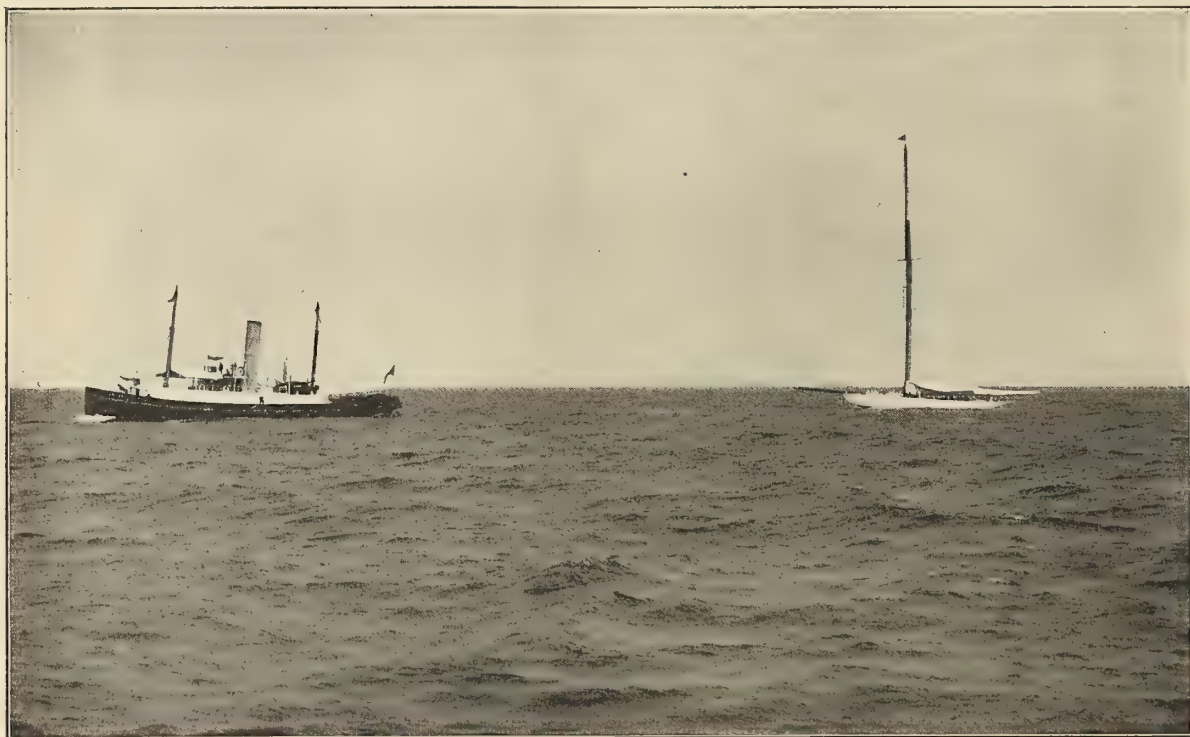
making and breaking said circuit at the quickest possible speed. The iron filings set themselves in line to transmit a wave, but when this ceases they are separated by tapping the tube. There are certain limitations to the speed of making and breaking the circuit through such an instrument, and it has been found that messages from a coherer cannot be sent much over a rate of ten words a minute. With the responder a speed of as high as sixty words per minute has been

obtained. In fact, the only limit in the speed is the skill of the operator.

The responder is not an anti-coherer; for although the reaction of the electric waves upon it causes a sudden increase in its resistance similar to that observed with the coherer, yet this fact is due to entirely different action. At the present writing, owing to the fact that certain patents are pending covering this instrument, further particulars pertaining to the theory and operation are not yet available. The responder is not only extremely sensitive, but is instantly restored to its normal condition between each electrical impulse, and it is at once ready to transmit succeeding impulses resulting from the discharge of the spark at the sending station. If the telephone earpiece is not desirable for detecting the messages, a relay may be substituted for the tele-

some time is required to recharge the condenser to the sparking potential. Hence the discharge is intermittent. In this device, by cutting off more or less resistance in the induction coil, any number of discharges may be secured. In other words, the apparatus can be tuned for practically any wave frequency. The mushroom type of discharge gap has been found best suited for this work.

Mr. De Forest has made use of the Lecher system for arrangement of the wires of his antenna. It consists of two parallel wires, connected at their ends to an apparatus producing electrical oscillations at high frequency, the wires being of the same length, and each one-quarter, or any multiple thereof, of the wave length of said electrical oscillation. Electromagnetic waves are then set up along the wires. If the corresponding nodes



SHAMROCK I. IN TOW OF TUGBOAT CRUIZER.

[Photographed specially for Marine Engineering by E. Muller.]

phone and the signals received on a Morse sounder. The telephone, however, seems to be preferred, and with it the receiving operator hears the dots and dashes emanating from the transmitting station. The responder works on a closed circuit and upon the current of an ordinary dry cell of several thousand ohms resistance.

A variable induction coil, shown in the plan connected to the condenser, is another very important feature of this apparatus. Up to this time it has been practically impossible to obtain a continuous stream of electromagnetic radiation adapted to this class of work. By varying the resistance of the induction coil, the number of electrical discharges across the spark gap may be obtained within any specified limits. In operation the dynamo charges the condenser, and when its potential reaches a certain point the discharge occurs across the spark gap, which sets up oscillations in the antenna wires. On account of the high resistance in the circuit,

and loops of electrical oscillations in the two wires be connected together, the waves will not be interrupted; and, further, if these bridges be grounded, they lead off waves of different length than those to which the system is adjusted or attuned. The responder is placed at half-way between the nodes, or at a loop where all the energy of the system is electrostatic, and the instrument will receive oscillations of the greatest intensity.

The inventor of this system, Mr. Lee De Forest, was graduated from Yale University in 1896. He made a specialty of the subject of the Herzian waves, taking a degree of Ph.D. for work along this line. The sending apparatus has been developed by Professor C. E. Freeman, E.E., of the Armour Institute of Technology. Also associated with Mr. De Forest in his work on the receiver was Mr. E. H. Smythe, of the Western Electrical Company. Basic claims for many important devices for transmitting and receiving apparatus, applied

for by Mr. De Forest, have been allowed with remarkably little delay at the Patent Office.

Many instances are related by the owners of the De Forest system of picking up wireless messages of other systems, and, in some instances, of transmitting other messages from their own station before same were detected by the intended station. True it is that the speed with which the De Forest messages may be sent is of very great importance.

The equipment on board the *Erin* is of one kilowatt capacity. The motor generator is placed at the right hand of view on page 446, underneath the table, and is run by current supplied from the storage battery of the yacht's lighting plant. The alternating current from the

schedule has been adopted simply for convenience. One interesting feature, which is specially valuable to Sir Thomas in his trying-out races of the two *Shamrocks*, is that, with this system, the presence of electrical storms may be detected. In the trial races between the boats much care has, of course, to be exercised, when spreading new sails and trying the spars, not to wet or bulge the sails or part any of the standing rigging or spars. Sandy Hook is a favorite spot for thunderstorms and squalls, but the approach of the latter may always be foretold by this serviceable equipment.

The two *Shamrocks* have been in almost daily contest since the first of the summer, and the superiority of the new boat has been shown in every race. Sir



SHAMROCK III. COMING ALONGSIDE THE ERIN.

[Specially photographed for Marine Engineering by E. Muller.]

generator is led to the choke transformer and then to the step-up transformer, where, as above stated, it is raised to a voltage of 20,000. From there one of the wires comes up through the table to the antenna and condenser. The condenser is shown at the left of the table, with the spark gap directly in front. The box on the right is the receiver. The operator's key is placed at the center of the table, in circuit between generator and transformer, and the message is sent according to the Morse alphabet. The switch shown is used for throwing in or out the receiver.

The system has worked most successfully on board the *Erin* and has been of great assistance to Sir Thomas Lipton. Messages are sent ashore on the hour and half-hour, and those from shore for the ship are sent out a quarter after and a quarter of the hour. This

Thomas Lipton has, as he states, come over here for the sole purpose of lifting the *America's* cup, and whether or not he will succeed is at this writing unknown; but sure it is that never has a foreign competitor held the esteem and affection of the American people to any such extent as has this gallant knight.

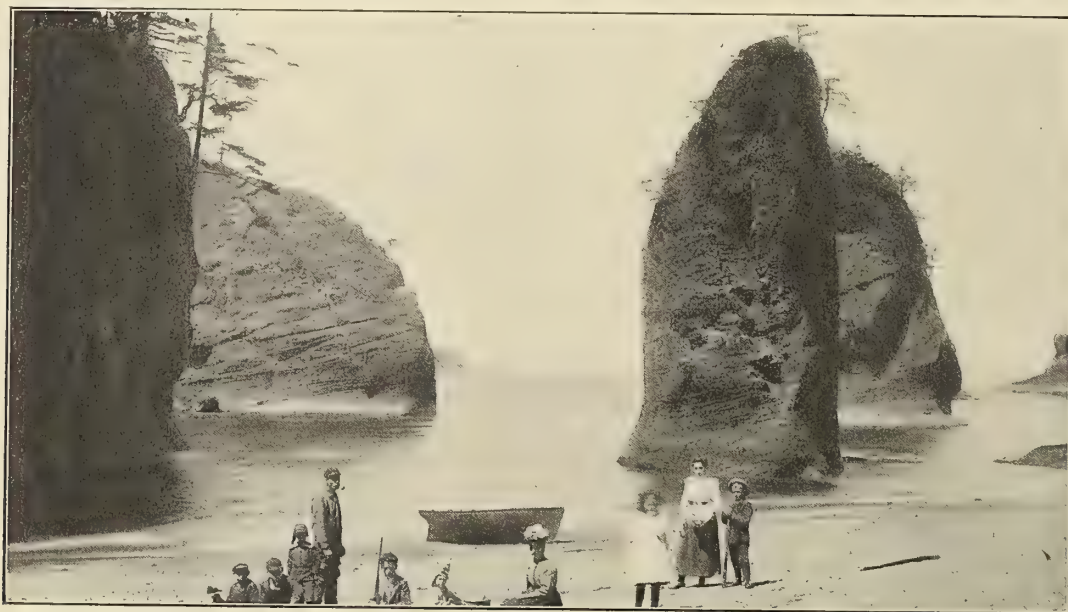
The *Erin*, designed by the famous Watson, is a yacht with most graceful lines. She is, in fact, in size and appointment almost a steamship. The quarters for owner, guests, and crew are all well arranged, and the former are most lavishly decorated and contain many interesting souvenirs of royal and other distinguished guests who have been the recipients of Sir Thomas' hospitality.

On pages 449 and 447 are given two most remarkable photographs of the *Shamrock III.*, one taken looking down on the challenger from the deck of the steam

yacht, showing how graceful and fair is the form throughout, and the other taken of *Shamrock III.*, in tow of the *Erin*, being brought home from a trial spin. The extreme height of mast in proportion to the narrow beam is clearly brought out.

The fourth vessel of this fleet, the tugboat *Cruizer*, should not be overlooked. She is a typical seagoing tug of the English type and was the consort of the *Shamrock I.* on the transatlantic voyage, as the *Erin* was the consort of *Shamrock III.*

Many other installations of the De Forest wireless telegraph have been made on board ships. The scout boat *Unique* during the Army and Navy maneuvers was equipped with a 1 K. W. alternating-current generator driven by a Secor engine. Although the *Unique* was a small boat and the weather during the maneuvers was rough, the service rendered was such as to call for a commendation from the Chief Signal Officer.



CAPE FLATTERY, WASH., WHERE A THREE-TOWER DE FOREST STATION IS TO BE ESTABLISHED FOR TRANSMITTING WIRELESS MESSAGES DISTANCES UP TO 2,000 MILES.

The steamship *Coamo*, of the Porto Rico Line, was fitted with the De Forest system; and to show the facility with which the apparatus may be installed, it is stated that it took but two hours to put the instrument and antenna in place ready for service. Many other vessels on the coast and lakes are being equipped with this system.

Experiments have shown that the distance of transmission varies with the capacity of the machine. At present a large station is nearing completion at Cape Hatteras for the purpose of reporting the passage of vessels at this most important point upon our coast, and its capacity will be sufficient to transmit messages to the Coney Island or Block Island station, 360 and 460 miles distant respectively. Above will be found a view taken at Cape Flattery, Wash., where a station of 60 K. W. capacity is now being built. This, it is stated, is the first of a line of stations along the Pacific shores of America and Asia for sending messages to the far East.

Oceangoing Steel Tug John Scully.

A large oceangoing tug built by John H. Dialogue and Son, of Camden, N. J., for service in the Gulf of Mexico, has recently been purchased by Scully's Towing and Transportation Line, of New York, for sea towing between this harbor and New England ports.

The principal dimensions of the *John Scully* are as follows: length over all, 150 feet 6 inches; beam, 26 feet; depth, 17 feet 3 inches. The hull is strongly built of mild steel, with usual iron deck house and pilot house, the crew's quarters being in the forecabin. There are 7 water-tight bulkheads extending to the main deck; the forward collision bulkhead forming the fore peak tank, two forward of the boiler room forming deep tank or coal bunker, two between engine and boiler rooms, with passageway running through, forming the main coal bunker, and two aft of the engine room forming the after water tank. Besides the above-mentioned coal

bunkers there are also wing bunkers alongside of boiler. The total capacity of the tanks is 60 tons, and coal bunkers have a capacity of about 300 tons.

The vessel is rigged in the usual manner for one of this class, with two pole masts. The equipment consists of two small boats, anchors, chains, galley stove, etc. The forward bitts are of cast iron, while the after bitts are of steel tubes stepped to a steel flat over the thrust bearing, which also supports the mainmast. There is also a steam windlass aft for hauling in hawser, and combined steam- and hand-steering gear of the Williamson pattern. As the boat was originally designed for hot climates, the two ventilators leading into the boiler room are extra large.

The vessel is driven by one set of vertical, inverted, direct-acting, triple-expansion, 3-cylinder engines, the cylinder diameters being 16 1-2, 24, and 41 inches with a common stroke of 30 inches. The cylinders are supported at the back by cast-iron columns forming the

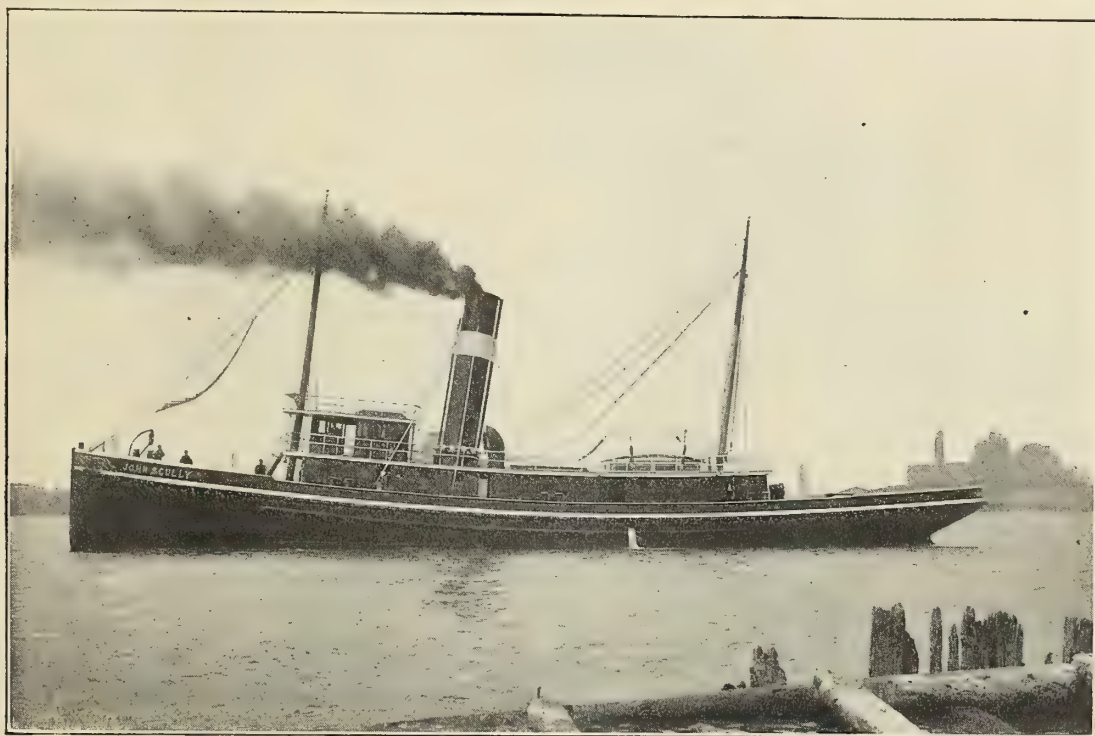
condenser, and on the front with wrought-iron columns. The guides are of the box pattern; the air, feed, and bilge pumps are worked from the main engine by levers from the intermediate crosshead; the circulating pump is independent and of the centrifugal type. The valves on the high- and intermediate-pressure cylinders are of the piston type, while the low-pressure has double-ported slide valves. The high-pressure valve has a removable liner and the low-pressure a removable face. All valves are on the forward side of cylinders and are operated by Stephenson double links. There is the usual steam reversing gear. The thrust shaft is made with collars fitted with horseshoe thrust bearings.

There is one single-end Scotch boiler, 14 feet 6 inches mean diameter and 11 feet 3 inches long. In this

Modern German, English, and American Electric Launches.—II.

BY FRANK C. PERKINS.

The popularity of the electric launch is increasing in England, and numbers of them are to be found throughout the island; on the Thames river alone there is a fleet of over 40. Among the modern English electric launches should be mentioned *The Titan*, which is 45 feet in length and licensed to carry 40 passengers. It was built at Weybridge, Surrey, England, at the works of the Thames Valley Launch Company, Ltd. This boat has 54 cells of battery of the Leitner type, the capacity being 280 ampere hours with a discharge current of 40 amperes. The speed of this electric launch is about 7 miles per hour, and it is propelled by a



SEAGOING STEEL TUG JOHN SCULLY.

boiler there are three corrugated steel furnaces, 45 inches mean inside diameter and 236 3 1/2-inch tubes, including both stay and ordinary tubes. Each furnace has a separate combustion chamber and the working pressure is 175 pounds. In the recess in the after boiler-room bulkhead is placed a vertical cross-flue donkey boiler, about 3 feet diameter by 7 feet high, which can be run with salt water if necessary.

Among the auxiliaries there is a filter and independent feed heater, and in the upper engine room are placed the steam-steering engine and horizontal evaporator, and steam fan for ventilating the fire room; there is also a very large dynamo direct connected to horizontal engine. The steamer is lighted throughout by electricity, while on the pilot house is placed a powerful searchlight.

This boat has been chartered by the New York Yacht Club to lay out the courses for the international yacht races.

Beevor-Edwards electric motor. It is built of teak, with handsome cabins well fitted throughout with plush and leather cushions.

Another handsome launch, built at the Riverside Works, is the *White Iris*. This electric boat is 30 feet long, and is driven at a speed of 8 miles an hour by means of the 5 H. P. electric motor.

The main works of the Thames Valley Launch Company, Ltd., as well as the principal charging station, are located at Weybridge, but there are other charging stations located at Maidenhead, Hurley, Henley, Pangbourne, and Shillingford.

It may be of interest to note the details of the W. Rowland-Edwards single-lever gear for electric launches, which is extensively used with success on the English electric boats. In the gear employed by the Thames Valley Launch Company, when one lever is switched on it gives the boat motion ahead or astern, at the same time varying the speed and stopping and

steering when necessary. The following quotation from the *Marine Engineer* gives a good idea of the method of operation of this apparatus:

"Heretofore boats of this description have had their motors reversed, which wears the brushes by the sharp edges catching against the commutator and causing sparking. Separate mechanism has been necessary, too, for starting, stopping, reversing, and steering the boat, requiring, of course, proportionate extra attention in consequence. With the armature of the motor, however, always running the one way, the brushes are simplified and the operations named effected by a single lever or wheel. The system provides for a reversible-bladed propeller, the blades being fixed to a sleeve on the main shaft, and when the blades are at right angles

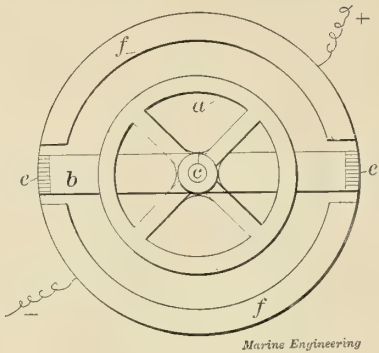
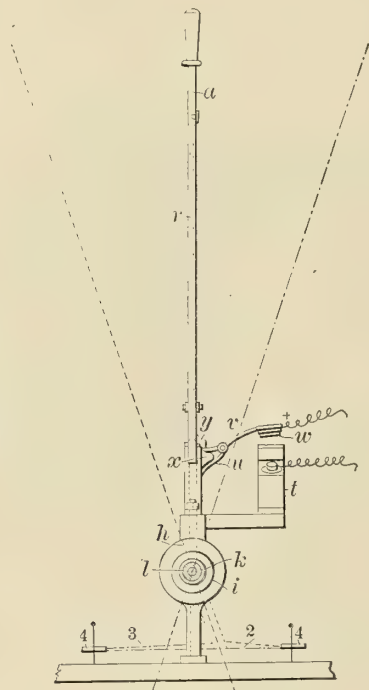


FIG. 1.



ENGLISH ELECTRIC LAUNCH CULLA RANEE.

to the shaft the propeller will simply revolve if the current is switched on, without doing useful work, and absorbing no current except that necessary to overcome the friction of the motor and shaft."

In the diagram, Fig. 1, a wheel, *a*, is placed in any convenient position in the boat for reversing. With it a bar, *b*, is insulated at its center, through which a spindle, *c*, passes and is fixed. This spindle is also connected to the wheel *a*, and at its lower end also to the rod or sleeve used for reversing the blades of the propeller. The bar *b*, insulated at its center, has upon each end conducting brushes *e*, *e*, and these brushes may slide over brass plates, *f*, which form segments of a circle electrically separated from each other, and only connected by means of the brush bar *b* when it is turned to the desired position by means of the wheel *a*. These segments are connected in the circuit by which the motor is actuated, and when the bar *b* connects them,

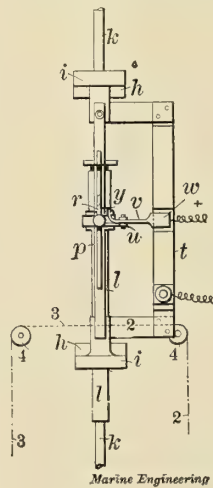


FIG. 2.

then the circuit is complete. If the wheel *a* is so placed that the blades of the propeller are at right angles to, or across the center line of, shaft—that is, in the neutral position—a gap or break is made in the brass segments *f*, so that the circuit is broken and no current passes. If the wheel *a* be turned slowly around in either direction, the blades of the propeller are also turned to the required angle with the shaft, and at the same time the brush bar *b* moves round and brings the brushes *e, e* into contact with the segments *f*, and so completes the circuit, and the boat commences to move forward or backward, according to the direction of the angle in which the propeller blades have been set, the motor itself always revolving in the one way. The current will be very slight at first, as there will be little resistance, and this will increase gradually as the blades are turned to a greater angle, and thus avoid a sudden rush of current, which is so detrimental to the motor

pivoted a lever, *v*, the outer end of which carries a brush, *w*, which is also in the electrical circuit, and a spring, *x*, tends to press the brush *w* against the metallic quadrant *t*. When, however, the lever *a* is in its central position, the catch *r* is forced into its notch, and a lateral projection, *y*, forces down the inner end of the lever *v* and breaks the contact between the brush *w* and the quadrant *t*. To a suitable part of the frame *h*, as at *i*, are attached ropes, 2, 3, which, after passing round pulleys 4, 4, are carried back to the tiller of the rudder, which they operate. As the motor is running always in one direction, it will not be injured if the lever is moved over from full speed ahead to full speed astern; and this is, of course, the most severe test to which the gear can be put. By this arrangement cells always work evenly and without rush of current, and, the motor always running one way, the annoying brush trouble is overcome.



ENGLISH ELECTRIC PATROL LAUNCH WHITE IRIS.

and cells. The latter may be in series instead of two sets in parallel, the current given out being uniform. A single circuit only is necessary, and any speed is possible from dead slow to full speed.

The lever *a*, in Fig. 2, is represented attached to the steering gear of the boat, so that steering can be effected either with or without the starting, stopping, and reversing devices described, thus enabling the whole of the movements named to take place by means of this single lever only. To do this the lever *a* turns upon a center, *k*, upon the lower part of a frame, *h*, which itself swings in bearings, *i i*, carrying the propeller shaft. The quadrant *p* is a guide for the lever in the usual way, there being a spring catch, *r*, and notch for the central position of the lever, the movement of which gives the different positions of the blades for either ahead or astern driving. A supplementary parallel quadrant, *t*, is carried by the frame *h*, and has a curved metallic face connected with the electrical circuit. The lever *a* is connected with a bracket, *u*, in which is

The *Culla Rance* was constructed at the Riverside Works and is a high-class private electric launch, 35 feet in length. It is equipped with a Beevor-Edwards motor and a storage battery of 34 cells, with a capacity of 150 ampere hours when the current taken by the motor is 30 amperes. This boat is built in teak and mahogany with walnut fittings. The beams, panels, and seats are of walnut, and cabins of the same are located at each end. The boat is electrically lighted, and fitted with velvet carpets and cushions, and silk curtains, with sliding doors at either end, and all modern conveniences.

The 35-foot electric launch *Livonia II.* is equipped with the W. Rowland-Edwards single-lever gear described above, and will run 50 miles with ease on a single charge of the accumulators. The storage battery equipment consists of 48 Leitner cells, having a capacity of 200 ampere hours with a discharge current of 28 amperes. This current will propel at the full speed of 9 miles per hour by means of the Beevor-Edwards electric motor with which it is equipped.

(To be continued.)

EXPERIMENTS ON THE RESISTANCE OF A
SCREW STEAMER IN FREE ROUTE.—II.

BY H. ENNO VAN GELDER.

In Fig. 4 is shown a graphical representation of the data given in Table I. On the diagram is also shown a curve, *e, e*, according to Rankine's formula (Rules and Tables, p. 275). This curve does not agree with that which is furnished by the experimental results taken from the thrust block, but varies widely, in particular at low speeds.

It would appear that the formula must be in error, for in the case under consideration the difference between two curves, the one giving experimental results and the other theoretical, can hardly be due to an improper construction of the propeller. The high value of the efficiency, 70 per cent., shows furthermore that the propeller in question was very efficient in form.

With the purpose of investigating the question as to

later proved by experiment, that at a given speed a ship propelled by its own propeller is subject to a greater resistance than if it were moved by a towline at the same speed. Froude named this difference "augmented resistance," which is here shown by the excess of the values of the thrust power in column 4 over those of the net or effective power given in column 5. In column 7 this excess is shown as a percentage of the corresponding value in column 5.

The graphical representations of these values, as shown in Fig. 5, give the following curves: Curve A shows the indicated horse power as given in column 2. Curve B shows the resistance of thrust power as given in column 4. Curve C shows the net or effective horse power as given in column 5, while curves D and E show respectively the values in columns 10 and 11. Curve E shows the fraction of the total indicated power which corresponds to that required to move the ship by a towline at the given speed.

TABLE II.

Number of Run.	I. H. P.		Thrust Power.	Effective Power.	Revolutions.	Increase due to augmentation, expressed as per cent. of col. 5.	Slip.	Speed, Knots.	Col. 4 Col. 2	Col. 5 Col. 2	C = $\frac{V^3 D^{\frac{5}{2}}}{H}$
	Developed.	Computed.									
1	31.03	26.38	19.76	15.80	94	25.06	1.55	6.97	63.68	50.9	183.3
2	50.56	45.24	33.16	27.42	111	20.90	3.47	8.07	65.58	54.2	174.5
3	80.24	74.36	53.22	42.74	127.5	24.50	6.04	9.02	66.32	53.3	153.6
4	132.35	128.67	89.43	70.69	148	26.50	9.60	10.07	67.57	53.4	129.6
5	170.83	176.37	118.85	87.75	160.5	35.40	13.40	10.47	69.57	51.4	112.8
6	230.58	246.44	161.40	108.46	175	48.80	17.37	10.84	70.00	47.0	92.8
7	260.32	278.91	180.29	120.22	180.5	49.90	19.04	11.01	69.25	46.2	81.1
1	2	3	4	5	6	7	8	9	10	11	12

DATA FOR SPECIAL THRUST BEARING.

Surface of collars.....	101 sq. in.	Moment	119.2
Maximum load.....	5,345 lbs.	Length of arm A.....	1 ft.
Coefficient of friction.....	.10	Pressure in direction BC.....	123.5 lbs.
Turning force.....	534.5	Load on slide	105 "
Moment arm.....	223 ft.	Surface of slide.....	52 sq. in.
	Load per unit area of slide.....		.31 lb.

how large an error would result from the Froude analysis and model research, at least in this particular case, two paraffine models were made of this form, respectively one-seventh and one-fourteenth full size, and these models were then subjected to the usual trials for resistance in the Dutch government model tank at Amsterdam, under the direction of Herr A. von Beck, naval engineer in charge of this work. The results are given in Table II. and are shown graphically in Fig. 8. In this table will be found, in columns 2, 4, 6, 8, 9, the values from Table I., columns 3, 12, 5, 11, 8, respectively, repeated for greater convenience of comparison. Column 5 gives the net horse power which, according to reckoning simply from the model experiment, would be needed in order to propel the ship at the corresponding speeds. In columns 10 and 11 are shown the thrust power (column 4, Table II.) and the net power (column 5, Table II.), expressed in per cent. of the actual indicated horse power (column 2, Table II.). In column 12 may be seen clearly the degree of error involved in the well-known Admiralty displacement formula:

$$C = \frac{D^{\frac{5}{2}} V^3}{H}$$

Froude first called attention to the fact, which was

Froude announced as the results of tests made in 1876 on the English ship *Greyhound* that in this particular case the value of this fraction, or the "propulsive coefficient," so-called, was found between 37 and 40 per cent., whereas Professor Flamm notes that under modern conditions the values will usually range from 40 to 54 per cent. According to the showing of curve E, or column 11, it is seen that the values in the present case vary between 46.2 and 54.2 per cent., thus agreeing well with those considered applicable in modern practice.

If we consider with further care the various losses which Froude's analysis contemplates, it is plainly shown that these figures, which are empirical in their determination, call for some modification in the present case. Froude gives for the resistance:

- (1) Due to the action of the propeller,
- (2) Due to the friction of the propeller in the water,
- (3) Due to the slip,
- (4) Due to the friction of the engine,
- (5) Due to the operation of the air, circulating, feed, and bilge pumps, respectively—the following values:
.4EHP, .1EHP, .1EHP, .286IHP, and .075IHP,

in which EHP denotes the effective horse power and IHP the indicated horse power as given in columns 5 and 2.

Froude takes for the slip loss 10 per cent. and from these various figures there results $E. H. P. \div I. H. P. = .287$. As we have already noted, the trials of the *Vlaardingen* show that this value under modern conditions, while variable, is considerably greater than Froude's values. The loss due to propeller friction is quite empirical, and in default of more accurate data we may take the value as given. As regards the slip

with an engine similar to that of the *Vlaardingen*, with a view of deriving some values of the friction loss, but this was ultimately found impracticable and the desired results in this particular were not therefore obtained.

Any one who has undertaken such experiments will realize that it is exceedingly difficult, if not impossible, to obtain good friction diagrams unless the engine is provided with flywheel of adequate capacity. From

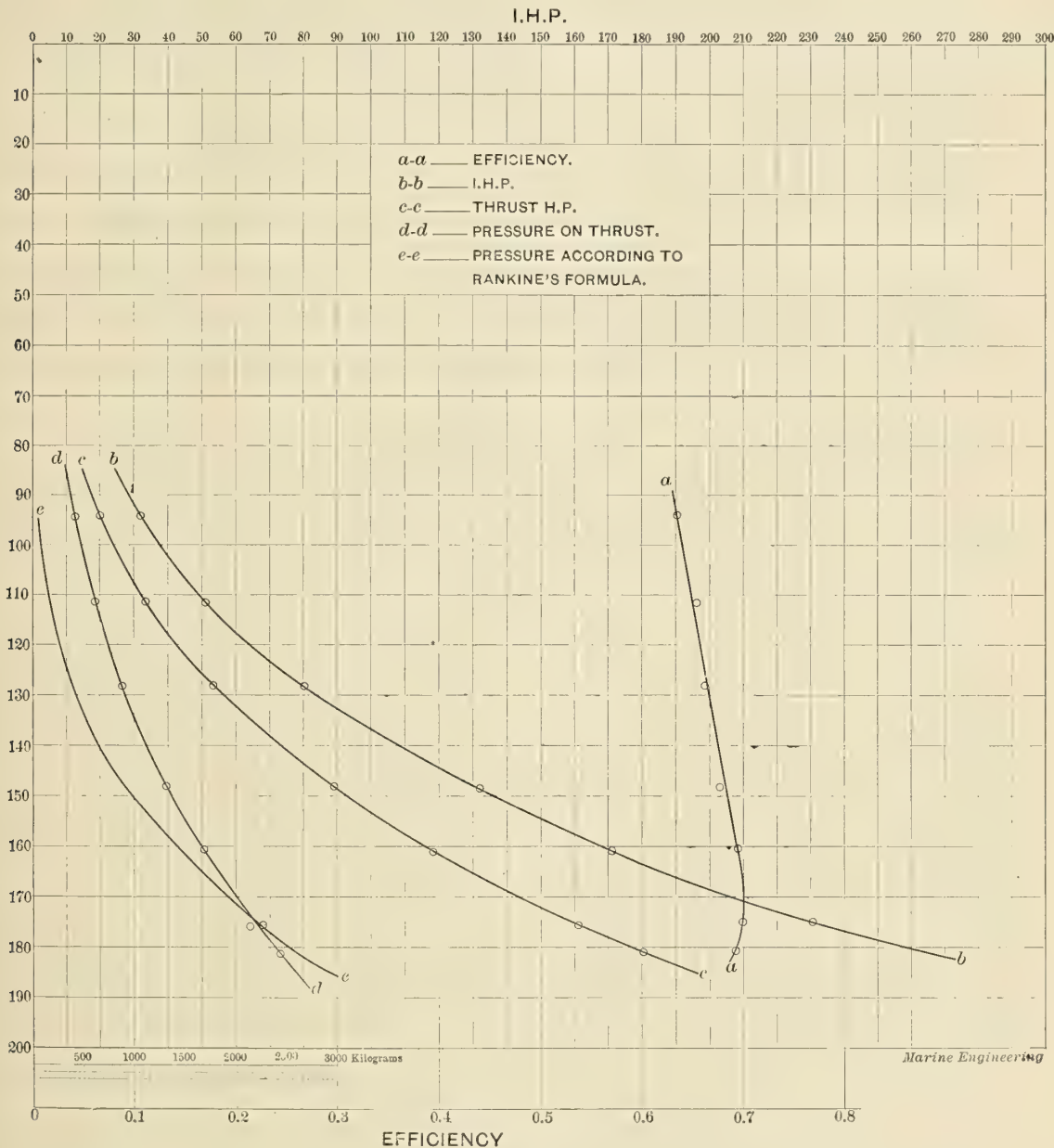


FIG. 4.

loss, we have in the present case definite values from which it is shown that it is variable and cannot be taken as constant under changing conditions. While the value of this loss cannot be determined *a priori* with accuracy, it must nevertheless be estimated in some manner. In the present case, however, the actual values can be determined from the data taken. The loss due to friction of the engine must still be arrived at by simple estimate. It had been intended to carry out certain experiments

such diagrams taken from stationary engines from time to time, however, it has been shown that the frictional loss in modern practice will usually be found about 12 per cent., and, based on such diagrams, this value may be adopted for the purpose of the present analysis, as sufficiently close for all practical requirements.

The work required to operate the pumps noted under (5) can usually be determined, if necessary, by direct measurement of revolutions and pressure from diagrams.

In the case of the *Vlaardingen* this was found to be about 6 per cent. of the I. H. P.

If now the various components of the work be computed after the manner of Froude's analysis, but with the corrected values given above, there result the figures in column 3, Table II., and which are also shown graphically by the curve F, Fig. 5.

While it is possible to thus include the work required

the same as for the earlier runs, the values for the wave line run being 1.24 forward and 2.25 aft.

At equal distances on the deck were stationed men with laths, by means of which during the run the distance at each station was measured from the rail to the surface of the water. From these indications the wave contour as shown in Fig. 1 was constructed. The form of the wave at this speed is quite favorable, since it re-

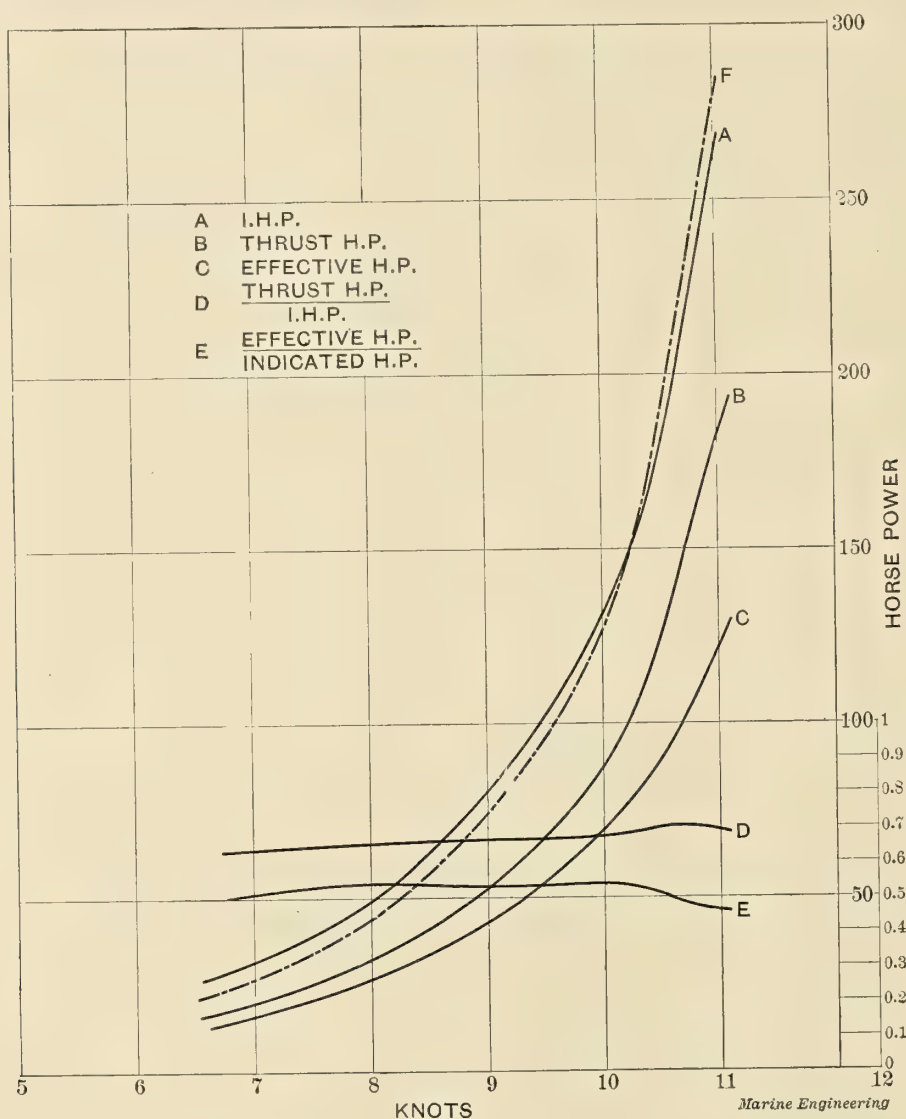


FIG. 5.

to operate the pumps, it is nevertheless better not to express the latter as a per cent. of the I. H. P., but rather to eliminate this item from the account, or rather to separately compute this part of the resistance work, having reference to the revolutions. Such an investigation gives the curve B, Fig. 6, which is seen to agree quite accurately with curve A, Fig. 6, the latter being the same as curve A, Fig. 5—that is, the curve of total I. H. P.

In connection with the investigation, the wave line developed at the speed of 11 knots was noted. As this run was made at a later time, the draft was no longer

sults in a considerable increase in the depth of immersion of the propeller and doubtless aids in the efficiency of its propulsive action. This wave contour agrees quite closely with that which was shown by the model at the corresponding speed.

Aft of the propeller, however, the ship wave is somewhat higher than the model wave, a result naturally arising from the operation of the propeller.

The more important results of this research may be summarized as follows:

(1) That the satisfactory determination of the percentage values of the constituents of the I. H. P. calls

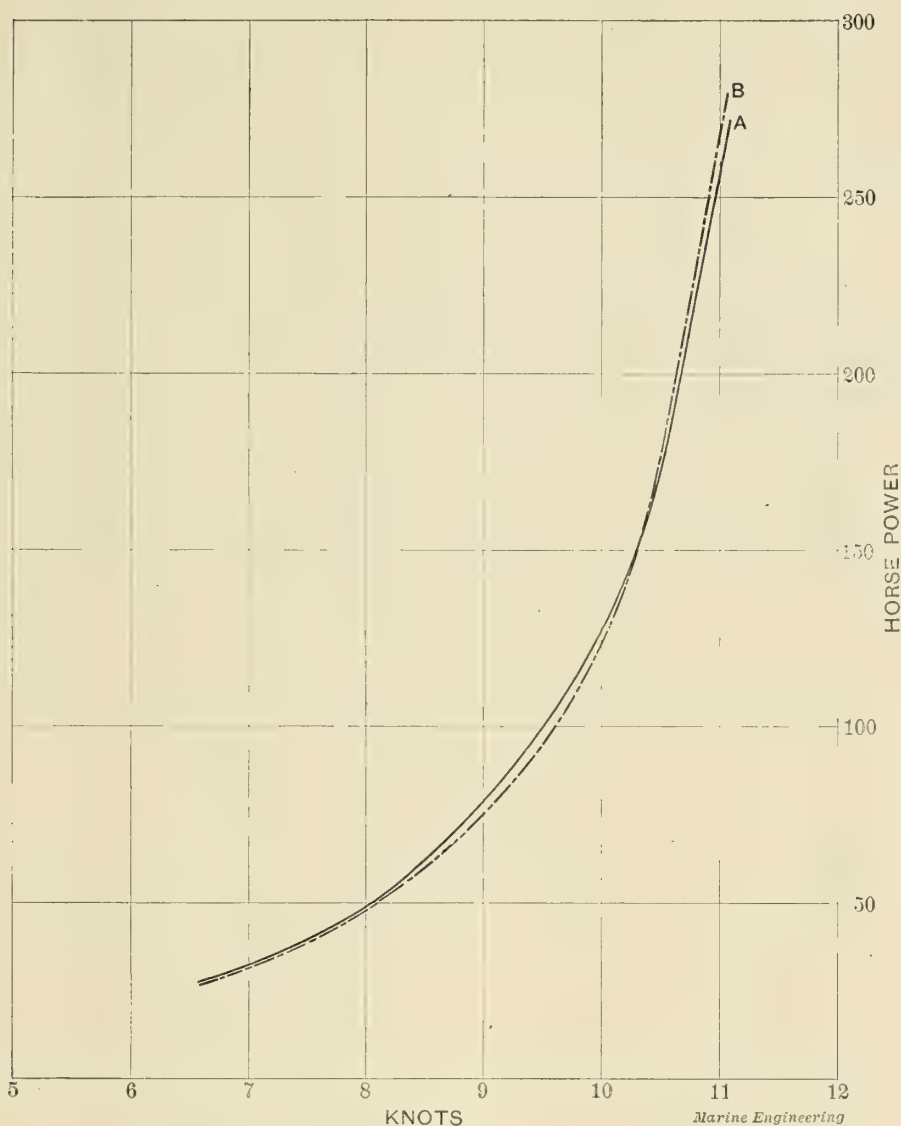


FIG. 6.

for continued experimental research on full-sized ships, and of well-selected types covering the field of marine design.

(2) That in my opinion there exists no technical reason why such experiments should not be carried out even with ships of still greater size.

It may furthermore be hoped that both builders and owners, whose common interest demands a clearer understanding of these matters, may unite to this end and allow no considerations of expense or loss of time to prevent the carrying out of such a series of experiments. In my opinion the government naval authorities may also aid in such a research through the provision of both material and labor, and by giving freely, for general benefit, the results thereby obtained.

Monthly Shipbuilding Returns.—The Bureau of Navigation of the Department of Commerce and Labor reports 117 vessels of 25,460 gross tons built in the United States and officially numbered during the month of July, 1903.

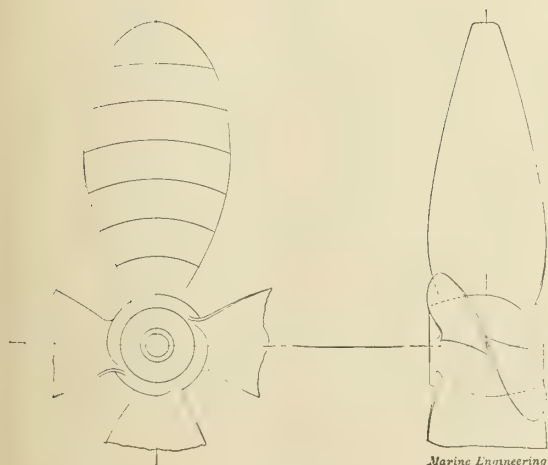


FIG. 7.

CURVE	A	B
Relative size of Model	$\frac{1}{4}$	$\frac{1}{14}$
Length of ship	72'	72'
Beam	14.75'	14.75'
Mean Draft	5.61'	5.61'
Displacement	70 tons	70 tons
Wetted surface	11925 sq. ft.	11925 sq. ft.
Total resistance derived by aid of		
model experiment at speed of 4	knots	216 lbs.
5	"	335 "
6	"	507 "
7	"	750 "
8	"	1080 "
9	"	1520 "
10	"	2226 "
10.5	"	2820 "
11	"	3515 "
11.25	"	4010 "
12	"	5586 "

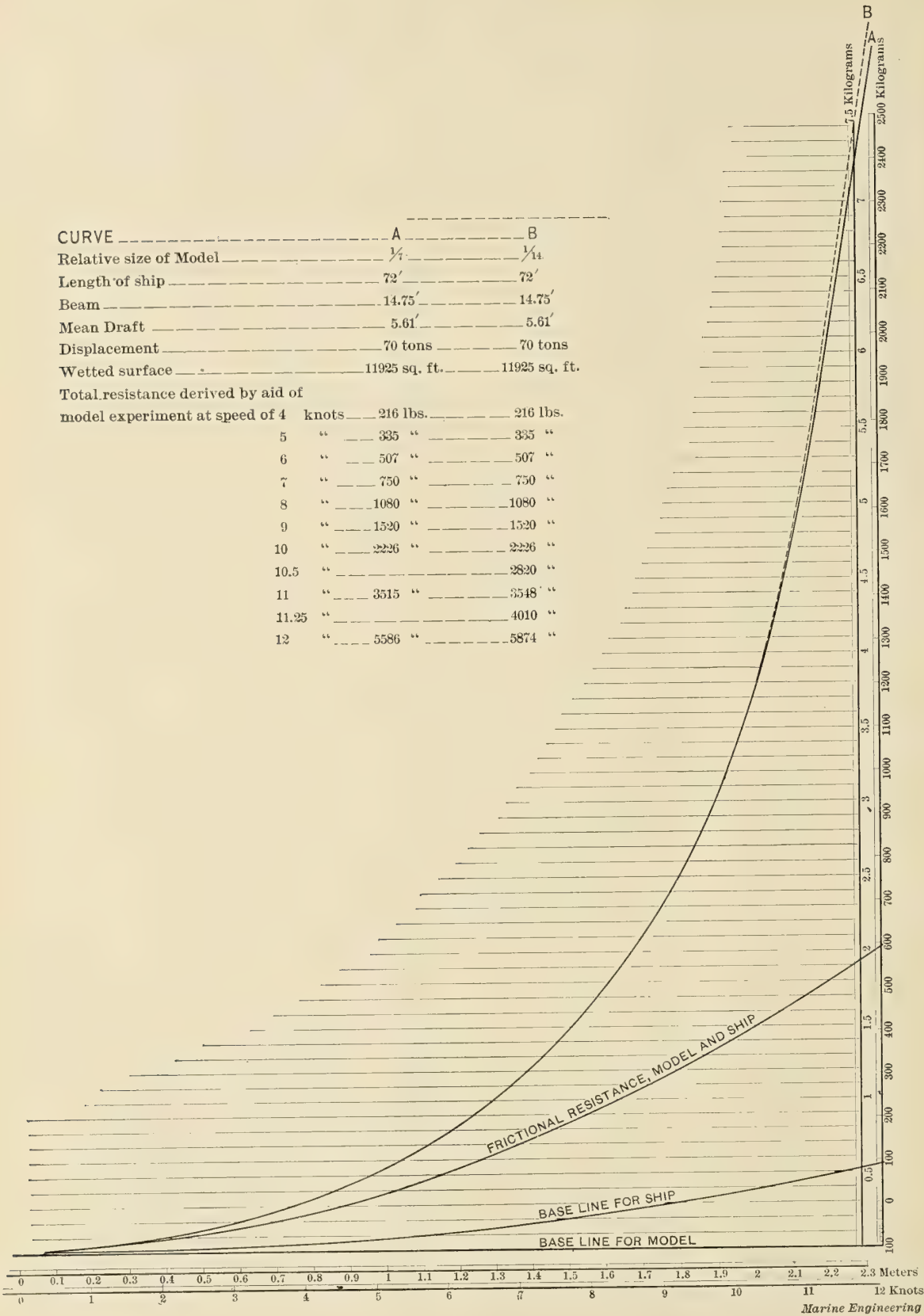
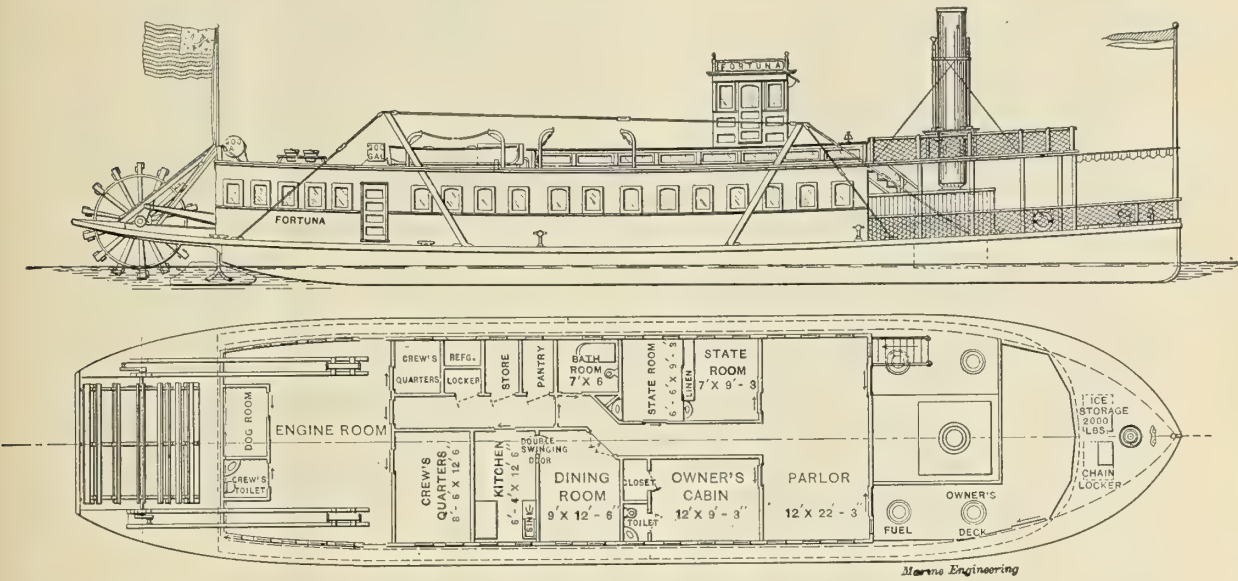


FIG. 8.

STERN-WHEEL STEAM YACHT FORTUNA.

The houseboat as a means of enjoying a comfortable summer outing was briefly described in the August number of MARINE ENGINEERING, and in the present

in the illustration on page 462. The owner's state room on the port side, and one of the two large guest rooms placed on the starboard side, are finished in mahogany, and the hallway, dining room, and second state room



DECK PLAN AND ELEVATION OF A SPORTSMAN'S YACHT FOR SERVICE ON WESTERN RIVERS.

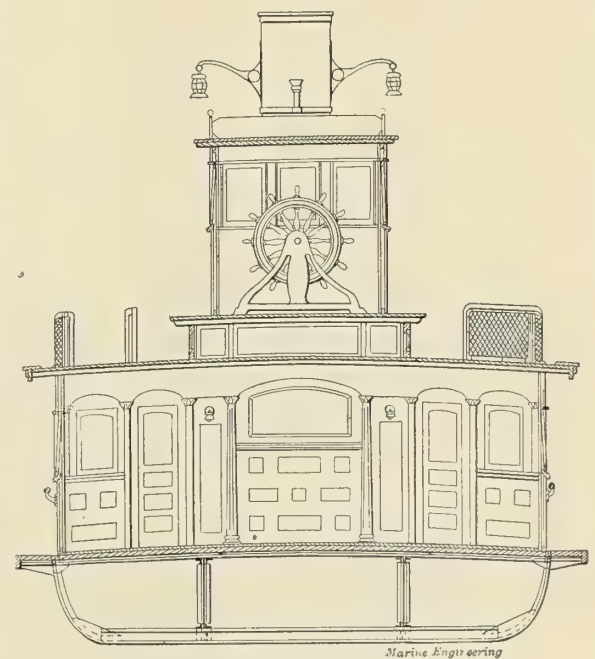
article, which deals with the steam yacht *Fortuna*, will be found a description of a boat which, though termed a yacht, and is such in the Western sense of the word, yet to all intents and purposes, to a salt-water sailor, embodies the advantages of the houseboat and, at the same time, permits of navigating shallow streams and at a good speed.

The *Fortuna* was built for a hunting boat by the Marine Iron Works, Chicago, Ill., for Mr. John W. Parmelee, Chicago. During the summer months the owner has cruised in Northern rivers and lakes, while in the winter the *Fortuna* will be taken to points where good fishing and hunting abound along the shores of Southern streams and the Gulf of Mexico.

Briefly described, the *Fortuna* is a stern-wheel boat 119 feet 9 inches from stem to after end of the paddle-wheel frame. Two simple engines are placed in the stern and a water-tube boiler is located forward. The hull is built of steel and subdivided into 7 water-tight compartments by 6 thwartship bulkheads. The deck house extends for a length of 70 feet amidships, and of this length 42 feet is devoted to the owner's quarters and accommodations for the crew. This type of boat is particularly desirable for a yacht, in that the choicest part of the craft, that amidships, is given over to the owner, while the engines and boilers are at the ends. In the steam yacht, as with other steam vessels of the ordinary type, this arrangement, as is well known, is reversed, and the owner must content himself with cabins at the ends of the vessel or in the deck house above.

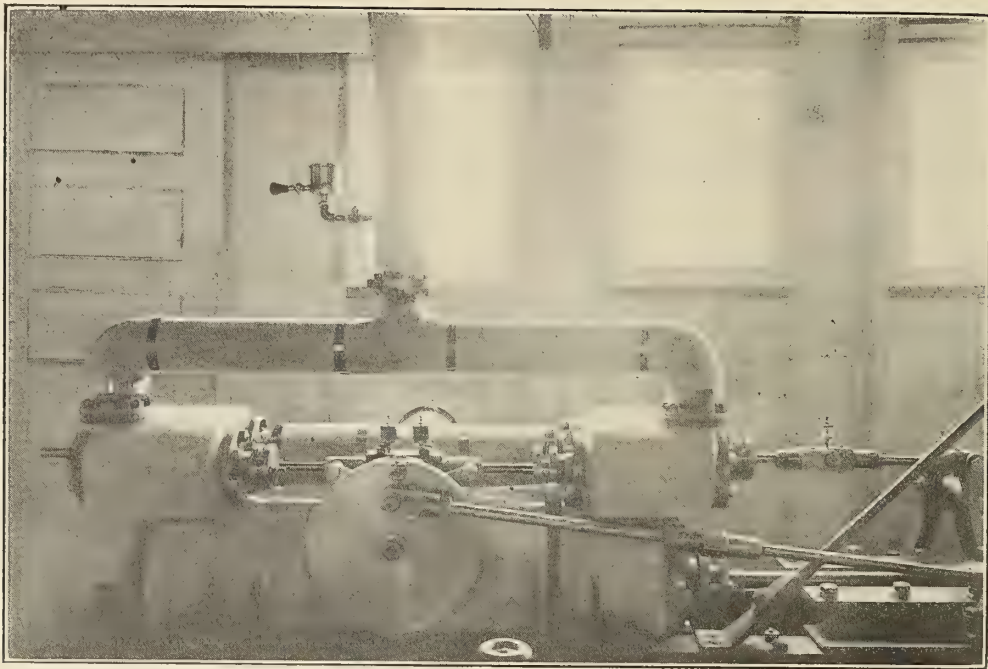
Referring to the plan on this page, it is seen that at the forward end of the yacht is a large parlor extending from side to side of the vessel. This large and airy room is finished in bird's-eye maple and is well shown

are finished in oak. A passageway 42 inches wide leads aft of the engine room. On the starboard side is the dining room, entered by double doors from the passage,



MIDSHIP SECTION OF THE FORTUNA.

and aft of it is the galley, which is wainscoted and has a tiled floor; on the port side a bath room, finished in bird's-eye maple with vitreous tiling and wainscoting, adjoins the state room. Passing through a sliding door, the rest of the passage is found to be devoted to pantry,



VALVE GEAR ON HIGH-PRESSURE ENGINE OF THE FORTUNA.

stores, crew's quarters, etc. The engine consists of two simple, direct-acting, horizontal engines, 9 inches diameter and 42 inches stroke, fitted with special patent cut-off valves operated by a wrist plate, as shown in the view above.

For a hunting boat to be complete there must be a place for the dogs; by referring to the plan it will be seen that there is a "dog room" at the after end of engine room.

The engines work on either end of the main shaft, which is 43-4 inches diameter and hexagonal section. The wheel is 13 feet diameter, fitted with 14 double buckets 12 feet 9 inches long. Each bucket is 81-2 inches wide, and those on the forward side of spokes overlap those on the after side by 11-2 inches, so that the total width of the face is 151-2 inches. With full pressure of steam, namely, 225 pounds, the engines will make 25 revolutions, developing 134 I. H. P., and will drive the vessel at a speed of 111-2 statute miles per hour.

The feed pump is a Worthington duplex outside-packed plunger 51-4 by 31-2 by 5 inches; there are two feed-water tanks, 1,000 gallons capacity each, and one Worthington duplex 3 by 2 by 3-inch tank pump for filling these tanks. One tank of 192 gallons capacity is used for sanitary purposes, and two tanks, each of this same capacity, are used for carrying drinking water. A 4 by 4-inch engine drives the electric-light dynamo by a noiseless chain at 600 revolutions. There are sixty 16-candle-power lamps fitted on board, also one 1,000-candle-power searchlight on top of pilot house. The water-tube boiler mentioned is placed forward on a level slightly below the water line, and coal is stowed in the hold through four coaling scuttles, two on either side. The normal supply of coal is 14 tons, while 17

NAME—Fortuna.	NATIONALITY—American.	TYPE—Western river yacht.
LAUNCHED—1903.	BUILDER—Marine Iron Works.	OWNER—John W. Parmelee
Length over all.....119 ft. 9 ins.	Number of buckets.....14	
" of hull.....103 "	Length ".....12 ft. 9 ins.	
Beam, molded.....23 "	Width of each bucket.....81-2 "	
" over guards.....26 " 6 "	Buckets overlap, actual total width of face.....151 2 "	
Depth, molded.....4 "	Revolutions.....25	
Draft, load.....2 "	I. H. P.....134	
Displacement.....107 1-2 tons	Speed.....11.5 mi es	
Gross tonnage.....150	Boilers: Number.....1	
Engines:	Type.....water-tube	
Type.....double high-pressure	Width.....8 ft.	
Cylinder diameters.....9 ins.	Length.....8 "	
Stroke.....42 "	One furnace.	
Valves.....piston, patent adjustable cut-off	H. S.....1,060 sq. ft.	
Length of pitman.....14 ft.	G. S.....41.6 "	
Wheel:	Steam pressure, 250 lbs. allowed;	
Diameter of shaft.....4 3-4 ins. hex.	225 lbs. average carried.	
" wheel.....13 ft.		



BOW AND STERN VIEWS OF THE FORTUNA AT THE DOCKS OF THE BUILDERS, THE MARINE IRON WORKS, CHICAGO, ILL.



MAIN CABIN ON THE FORTUNA.

tons may be carried. The boiler is 8 feet square and has a grate 6 feet 8 inches square, thus giving a grate surface of 41.6 square feet; the total heating surface is 1,060 square feet. There are two feet of deck around the main house over the guards, with hand railing placed at the inside. The deck forward is built of Douglas fir, and is fitted up for the owner, while at the bow are two hatches, one for a chain locker and the other for ice storage for 2,000 pounds. Here are also placed the anchor davit, bits, and capstan. A stairway at the side leads to upper deck, the forward end of which is railed off for the owner. The pilot house is on top of dome.

This convenient and unique type of vessel is but another illustration of the ingenuity of the designer to carry out the requirements of an owner for a special type of boat.

Webb's Academy and Home for Shipbuilding.—The ninth annual report of Webb's Academy and Home for Shipbuilders has been issued, presenting a prosperous condition of the Academy, both financial and in its educational work. The institution was completed in May, 1894, and presented by Mr. William Henry Webb to the trustees together with an endowment for its maintenance in perpetuity. As is well known, this institution affords free relief and support to aged men who have been engaged in building ships in this country, and also furnishes young Americans a gratuitous education in the art and science of shipbuilding and marine engineering. This year's graduating class numbered sixteen. A register of the graduates of the classes since 1897 shows that with hardly an exception, they have all followed the profession studied at the academy and have met with exceptional success.

STEAM TURBINES.*

BY PROFESSOR RATEAU, PARIS.

As is generally known, it is to the Hon. C. A. Parsons principally, and to the Swedish engineer De Laval, that is owing the general introduction of the steam turbine into practical engineering during the last ten years. It should, however, not be forgotten that the idea of this type of motor had already taken form in the brains of several inventors, and that, among them, the French engineer Tournaire is entitled to particular mention as having in 1853, just half a century ago, indicated the capabilities of the steam turbine. The disposition Tournaire indicated is almost exactly that developed thirty-two years later by Mr. Parsons, with, it is true, some very ingenious improvements which have assured the success of the engine. Tournaire also conceived the helicoidal gearing since adopted in the De Laval system.

As in the case of reciprocating steam engines, steam turbines are heat engines, converting the calorific energy of the steam into directly-available mechanical energy. From another point of view they are analogous to hydraulic turbines, and form part of the general class which the author will call "turbo-machines." To a person well grounded in the thermodynamic properties of steam, and possessed also of a thorough knowledge of the theory of the hydraulic turbine, nothing is easier than to design with confidence a steam turbine to satisfy a given purpose, provided, it should be understood, that he has previously determined the working coefficients to introduce into his calculations. Piston engines are not susceptible of such exact calculations, owing to losses at the admission and exhaust ports, and also to

*Paper read at the Engineering Conference of the Institution of Civil Engineers, Section V. *Shipbuilding*, June 19, 1903.

cylinder condensation. In turbines the expansion of the elastic fluid can be pushed to its extreme limit much more conveniently than in the case of piston engines, whence they share the advantage of employing condensers giving the best possible vacuum. On the other hand, friction and leakage increase in proportion as the pressure is raised. From these opposite conditions it results that, for low pressures, turbines are more advantageous than reciprocating engines, while they generally consume more than the latter when the pressure of the exhaust is that of the atmosphere, or higher.

As in the case of their hydraulic analogues, steam turbines may be divided into two principal classes—action and reaction turbines; and each of these classes is subdivided accordingly as the turbine is composed of a single wheel or of several wheels, traversed successively by the steam in course of expansion. Among reaction turbines (analogous in hydraulics to the well-known Jonval turbine), of which, as multiple machines, the prototype is the Parsons turbine, the steam is only partially expanded in the distribution, and acquires its full expansion in the movable wheel. The steam therefore acts on the blades at once by its pressure and its velocity. The movable wheel is thus subjected on its two faces to pressures of different amounts, causing longitudinal thrust, which has to be balanced. These differences of pressure render it necessary to reduce to a minimum the clearance between the movable wheel and the wall by which the steam tends to escape without traversing the blades and so doing useful work. It is indispensable that the distribution of the steam should be effected over the whole circumference of the movable wheel, in order to avoid movements of pulsation very prejudicial to efficiency.

In the "action" turbine, on the other hand, the steam only acts on the movable wheels by its velocity. Each wheel revolves in a casing in which the pressure is uniform. Therefore the steam does not produce any sensible longitudinal thrust on the moving parts, which dispenses with the necessity for any special provision to neutralize such thrust. The steam does not tend to rush across the blades in order to pass from one face to the other at the expense of efficiency. It is therefore possible to provide sensible clearance between the moving and fixed parts, and consequently to disregard the wear of the shaft bearing. Further, it is possible, if need be, to project the steam on to one point only of the circumference. Finally, under the same conditions, "action" turbines revolve at a less velocity than "reaction" turbines. This renders more easy the direct coupling to the machines worked.

The prototype of the simple-action turbine is that of De Laval. The author conceives that the multiple-action turbine offers greater advantages. It is therefore a motor of this type that he has developed latterly. His turbine, known as the "multicellular," is composed of sheet-iron wheels in greater or less number, fixed on the same shaft, and separated one from another by flat diaphragms. Many of these machines are already at work. Wheels of single sheet iron suffice up to a diameter of about 1 meter (39 inches); above this diameter it has been found advisable, in order to avoid deformation, to make the wheels of two conical disks of that metal. These multicellular "action" turbines can be

disposed so as to run with very little loss from friction or from leakage, and, as a result, the consumption of steam is proportionately small at any load.

It is not necessary to insist on the well-known advantage possessed by turbines in general of their smooth and continuous movement of rotation; but the excessive speed for which they are obliged to be designed, in order to meet the speed of flow of the steam, constitutes in many cases a serious inconvenience—e.g., in its application to ship propulsion. For a long time this hampered their use for electric installation, but latterly dynamos of very high speed have been constructed, worked by steam turbines, constituting an outfit of light weight, requiring small space, and, although of ample power, of low cost, and, as a consequence of working and upkeep, as simple as can be desired. It follows that for this purpose the steam turbine may be expected rapidly to supplant the piston engine.

Direct-coupled to ventilators and centrifugal pumps, steam turbines, owing to their capability of producing great power at high speed, exhibit surprising results. The author has installed turbo-ventilators giving a pressure of half an atmosphere, and turbo-pumps with a lift of several hundred meters. He is prepared to instal plants of several thousand horse power compressing air to more than 6 atmospheres, or raising water to more than 600 meters (say 2,000 feet). This shows that the steam turbine possesses vast possibilities.

DISCUSSION.

In London *Engineering* the following discussion on Professor Rateau's turbine will be found, and is condensed as follows:

The discussion was opened by Mr. Jude, who stated that more data were wanted before the condensing reciprocating engine could be discarded. A good deal was said about working with turbines with low vacua, but he would like to know what was the extra cost. Marine engineers reckoned that 26 inches was very good, but the turbine people all spoke of 28 inches. What had to be paid for this extra 2 inches? The author had made reference to working coefficients, but it would be necessary to know what was their nature before an opinion could be formed; these things were known of the ordinary engine, but the turbine opened up a new field. Some time ago M. Rateau had made experiments, which had been published, on the flow of steam through orifices; but these orifices were of a regular nature and very different from the passages through the turbine. It might be that if the coefficients were taken from these experiments and applied to the working of the turbine, the deductions formed from such theoretical tests might be found illusory. The author said that in the multicellular turbine there was no fall in pressure in the cell. He asked if this statement was founded on observation. Had the author ever taken measurements to prove the fact? It was maintained that there could be no fall in pressure, as there was no thrust. Certainly the thrust must be small, as there was no thrust block; but it was desirable to know what were the absolute facts of the case.

Mr. H. F. Fullagar, who was the next speaker, admitted that, as Professor Rateau had said, given the necessary constants, it was a perfectly straightforward problem to design a turbine of a given power to run at a

given speed, and to foretell with scientific accuracy the steam consumption. But he would draw attention to the reason which made the problem increasingly easy as the power was increased, so that the building of large turbines was a matter of the greatest certainty. The feature which really distinguished the De Laval from other turbines was that, as the whole expansion of the steam took place in a jet, leakage was avoided. On the other hand, as the jet was necessarily inclined to the plane of the wheel, the axial component of the velocity—usually one-third (equal to one-ninth of the energy of the steam)—was lost, and, what was in practice more serious, the turbine was suited for full speed only, a reduction in speed being followed by a wholly disproportionate reduction in efficiency. The Curtis turbine shared to some extent both these disadvantages, but especially the latter, and was apparently unsuited to marine purposes. Large turbines then would, for the most part, be of the multiple type, in which there was a gradual fall of pressure from end to end; and the problem of leakage then presented itself, whatever the particular design might be. In M. Rateau's turbine, for instance, there was certainly no difference of pressure in the chambers themselves, and therefore no tendency to leakage around the wheels; in fact, M. Rateau was able to make wheels, up to a yard or so in diameter, of sheet steel about 1-8 inch thick only, which would be incapable of resisting even a slight pressure. But there was a very rapid drop of pressure as the steam passed through the diaphragms, and in consequence leakage occurred at the holes in these through which the shaft passed. The great point was, however, that, given two turbines of the same design, and but one, say, ten times the power of the other, the larger turbine could not only run at one-fifth of the revolutions, but the percentage of steam lost by leakage would at the same time be one-half that lost with the smaller turbine; and that followed directly and necessarily from the simple increase in the diameter of the turbine. The first speaker had referred to the high vacuum asked for by turbine makers as if it were an indispensable requisite of the turbine; the real fact being, of course, that, as the relation of pressure to volume showed a slight reduction in the terminal pressure, when near the bottom of the scale, it added enormously to the available energy of the steam; and of that, whilst lost on the reciprocating engine, the turbine could take full advantage.

Mr. Barker, engineer of the Parsons Steam Turbine Company, speaking on the question of vacuum, said that going from 27 inches to 28 inches was an increase of 5 per cent. in the power developed; extra speed was given to the circulating water. The question to be settled was, what was the greatest amount of power that could be generated with a given amount of coal? In other words, what could they afford to pay for power? He would ask the author whether there was any trouble from deterioration of the internal parts of the Rateau turbine. In the Parsons turbine they had no difficulty, but the velocities of steam with M. Rateau's turbine were considerably higher, and he thought there might be some trouble in this respect. He anticipated, also, that the cost of repair would be greater with the Rateau turbine, and there would be more difficulty in executing repairs at sea. Governing was not so much a question

affecting marine work as of electrical generation; but they were able to work within 1 per cent. to 1-2 per cent. of the normal. Could this be effected by the Rateau turbine? It would also be interesting to hear what was the consumption of oil. That was a subject which was being pressed on engineers. It was claimed for the Rateau turbine that there was no thrust; but that was actually a drawback for marine propulsion, as the thrust of the propeller was balanced by that of the steam, and, for this reason, with the Parsons turbine they could dispense with the thrust block.

Mr. C. A. Parsons stated that the French engineer Tournaire had published, thirty years ago, a description of a turbine with steam directed radially and outward, as that described by M. Rateau, but the results obtained were not equal to those of the parallel flow. The consumption at no load was high, and at full load it was not good. It was not right, however, to think that there was any radical difference between the two turbines. With the Curtis turbine it was a mistake to suppose there was a loss owing to longitudinal velocity; the loss that existed was due to friction. In regard to very low-pressure steam, about six years ago he had offered to take the engines out of the *Ireland* and put in steam turbines indicating 2,000 horse power more; that is to say, to go from 6,000 horse power to 8,000 horse power. The leakage in large turbines of 300 to 500 horse power, and above, was not serious at all—about 5 per cent. This had been ascertained by careful measurement, and the loss was about one-fifth of that due to condensation in the cylinders of ordinary engines. With the smaller sizes of turbines, however, the loss through leakage was serious. They had tried every possible device to get over this, but were always disappointed, skin friction being more than an offset for anything gained by checking the unobstructed flow of steam. They had succeeded in stopping the leakage, but the turbine was 15 per cent. less efficient than when no efforts were made in this direction. It would be interesting to know what were the results obtained with the torpedo boat built for the French navy and propelled by Rateau turbines. In regard to the parallel-flow turbine, he thought the success was sufficiently proved by the fact that such engines, of many thousands of horse power, had been made for driving dynamos, especially alternators, and had been successfully used for very many years; for the business of making them was by no means a new one.

M. Rateau's rejoinder in closing the discussion will be given later.

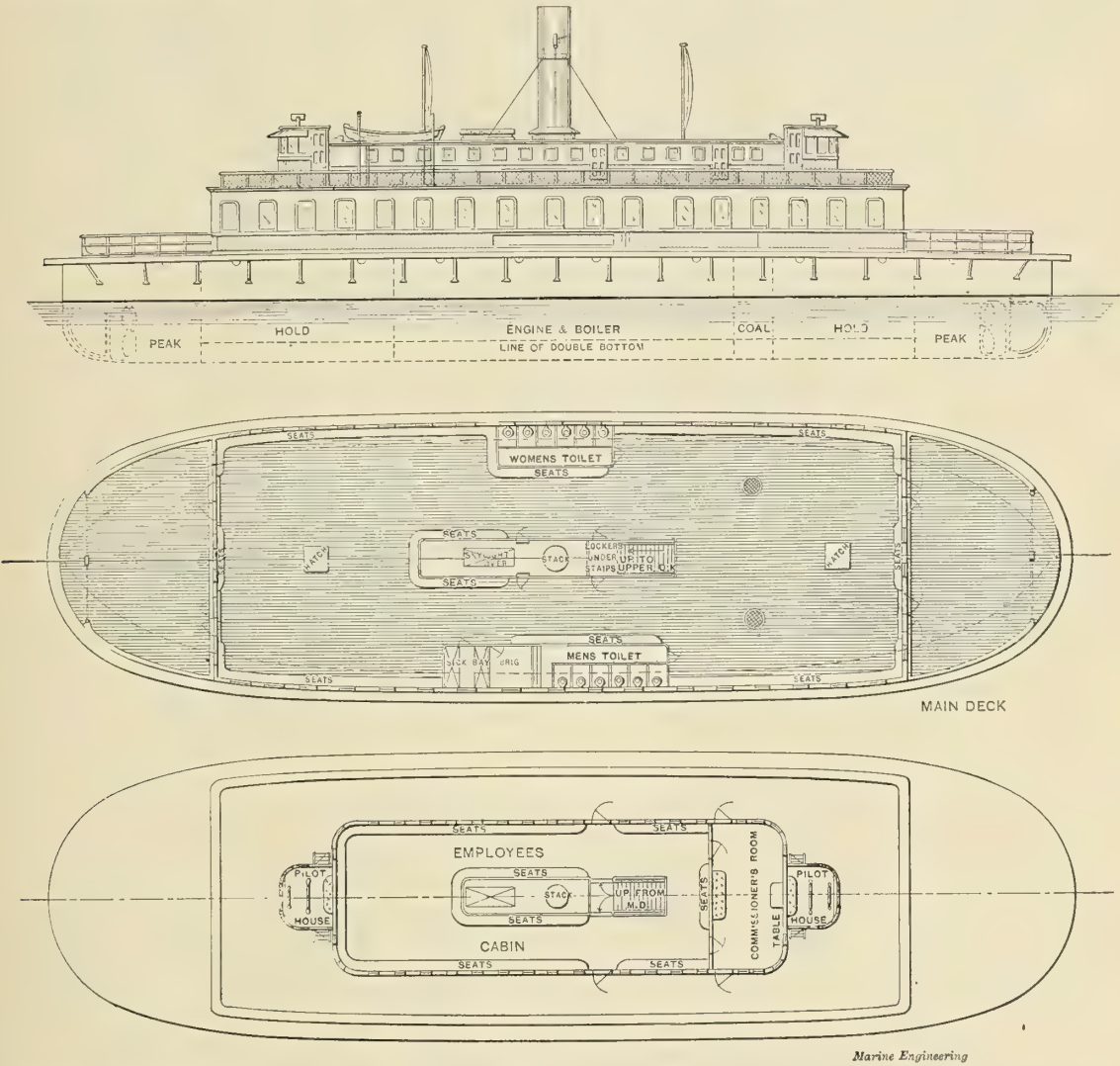
Foreclosed Mortgage.—A suit to foreclose the mortgage of \$16,000,000 on the property of the United States Shipbuilding Company was commenced in the United States court at Trenton against James Smith, Jr., receiver, by the Mercantile Trust Company of New York as trustee. The only property of the United States Shipbuilding Company not covered by the mortgage is the Bethlehem Steel Works, on which a mortgage of \$10,000,000 was previously given to the New York Security and Trust Company as trustee for the issue of gold bonds. It is alleged that the shipbuilding company defaulted the semi-annual interest of \$400,000 due July 1, and a further sum of \$200,000 which was to go into the sinking fund for the retirement of gold bonds.

ELLIS ISLAND FERRYBOAT.

The contract for the design and building of a new ferryboat to run between the Barge Office and the United States Immigration Station at Ellis Island, New York harbor, has been awarded to the Harlan and Hollingsworth Company, Wilmington, Del., one of the constituent companies of the United States Shipbuilding Company. The boat is to be ready for service the latter part of the winter, and will take the place of the old side-wheel steamer *John G. Carlisle*.

CONSTRUCTION.

The hull and center house are to be built entirely of steel, and the five water-tight bulkheads are located as shown on the accompanying plan. The keelson is a continuous vertical plate, 42 inches deep, made up in as long lengths as possible of 17 1-2-pound material. The butts of the keelson are to have double straps treble-riveted. The keelson extends 6 inches below the base, and two side bars, 6 inches deep and 30 pounds per square foot, together with the lower edges of the



ELEVATION AND DECK PLANS OF THE NEW ELLIS ISLAND FERRYBOAT, TO BE BUILT BY THE HARLAN AND HOLLINGSWORTH COMPANY, WILMINGTON, DEL.

The specifications and drawings call for a double-end ferryboat driven by two screws, one at either end. In designing the boat the Harlan and Hollingsworth Company has endeavored to make the general appearance good and at the same time have the arrangement and detail such that they conform in every way to the special service required.

The dimensions of the boat will be found in the data card, and the length over all is 160 feet. The draft is specified not to exceed 9 feet 3 inches, and the service speed must be at least 12 statute miles per hour.

two garboard strakes, form the outer keel. The vessel is to have a double bottom 36 inches deep at the center, extending between the collision bulkheads, and must be capable of carrying 15,000 gallons of fresh water when necessary. Each end of the double bottom is to be made into a feed tank for boiler use by fitting a water-tight floor.

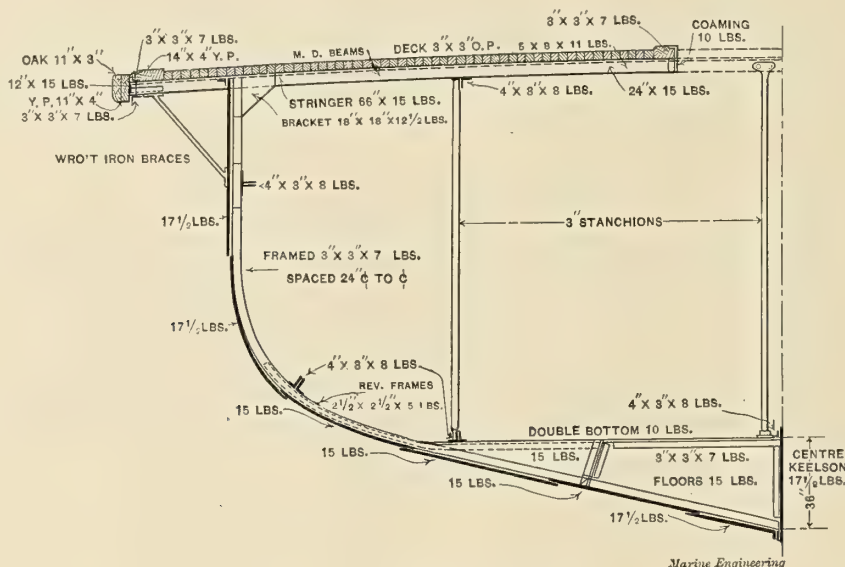
The keelson is connected to the 10 pounds per square foot double bottom plating by angle 4 by 3 inches by 8 pounds. The frames are 3 1-2 by 3 inches by 7.9 pounds per foot plain angles spaced 24 inches between

centers between collision bulkheads. Beyond these bulkheads the spacing is 15 inches. Frames in the double bottom are 2 I-2 by 2 I-2-inch by 5.1-pound angles. The reverse bars are 2 I-2 by 2 I-2-inch by 5.1-pound bars extending along top of floors to deck on alternate frames and to a distance of 6 inches beyond the bilge keelson on intermediate frames. Reverse frames are to be double under engines and boilers; the extra reverse frame extends to the bilge keelson.

The floor plates are to be 36 inches deep and 15 pounds in way of double bottom, except under engine and boilers, where the weight is 18 pounds. At the ends of the vessel the depth of the floor plates is increased. The floors are connected to the center keelson by double angles, 3 by 3 inches by 7.2 pounds, and to double bottom and marginal plates by single 2 I-2 by 2 I-2-inch by 5.1-pound angles. On each side of the vessel there are to be 4 belt frames, 14 inches wide by 12 I-2 pounds

erally; the sheer to the sides and the garboard to bottom to be double. Butts of shell plates are to be lapped and treble-riveted. The entire sheer and garboard strakes, and the water-line strake for a distance of 100 feet amidships, are to be 17 I-2 pounds. The side, bilge, and bottom strakes are to be 15 pounds. The water-line strake at each end will have plates 20 pounds per square foot.

The main stringer will be 66 inches by 15 pounds, connected to the sheer strake by 3 by 3-inch by 7.2-pound angles. Tie plates 24 inches wide, of 15 pounds weight, will extend along the sides of the center house to the deck plating on each end. In way of the boilers the deck is to be covered by plates 7 I-2 pounds per square foot. On the guards the lower rim plate is to be 10 inches wide by 15 pounds. The face plate is to be 12 inches deep by 15 pounds, secured to the stringer by continuous 3 by 3-inch by 7.2-pound angles at top and



MIDSHIP SECTION OF FERRYBOAT FOR ELLIS ISLAND SERVICE OF THE DEPARTMENT OF COMMERCE AND LABOR.

weight, faced with double 2 I-2 by 2 I-2-inch by 5.1-pound angles in one length.

The end post, 6 by 3 inches; the rudder post, 6 by 3 I-2 inches; and the stern post, 6 by 4 inches, are all to be of cast steel. The stern post is to extend 6 feet into the vessel, with a 22-inch scarf for connection to the keel. The rudder frames are to be of cast steel with stocks 4 I-2 inches diameter.

The deck beams are 5 by 3 inches by 11.2 pounds on every frame, and connected to frames by gusset plates 18 by 18 inches by 12 I-2 pounds. Alternate beams extend from guard to guard, and are to be collared where they pass through the sheer strake. The sister keelson, bilge keelson, and side stringer are composed each of double 4 by 3-inch by 8-pound foot angles riveted back to back. They are to extend as far into the ends of vessel as possible and to terminate in breast hooks where practicable. All are bracketed to water-tight bulkheads and not run through.

The shell plating is to be arranged inside and outside alternately. The landings will be single-riveted gen-

erally; the sheer to the sides and the garboard to bottom, and to ends of beams by clips. The guard braces are to be solid, 2 I-2 inches in diameter, with forged heads and feet to secure them to the guard beams and the sheer strake.

The five water-tight bulkheads are to be built of 10-pound plates and stiffened vertically by 3 I-2 by 3 inch by 7.9-pound angles spaced 24 inches apart. The horizontal stiffeners on the opposite side are to be angles of the same size, spaced 48 inches apart. Each bulkhead is to be fitted with a hinged water-tight door. Ridge bars of double 4 by 3 inches by 8 I-2 pounds per square foot angles are to be secured to under side of deck beams on each side of vessel by clips 12 inches long. The stanchions, which are to be fitted under the ridge bars and on the center line where practicable, are to be made of 3-inch extra heavy wrought-iron pipe having malleable cast heads and feet.

The engine foundation is to be built up of 25-pound plating, and the double bottom in way of the bed plate is to be strengthened, and hollowed out in way of connecting rod. The coal bunkers, situated athwartships

as shown on the plan, will contain about 20 tons, and will be filled through two 17-inch scuttles in the main deck. The center house will be of steel and will extend over engines and boilers between main and cabin decks and over boilers only above cabin deck. The plating will be 8 pounds in way of main deck and 6 pounds in way of cabin. All plates to be vertical and stiffened by 4 by 2 1-2 inches by 6.1 pounds per foot T-bars. A steel bulkhead will divide the engine and boiler spaces between the main and cabin decks. The weight of each rudder is to be taken on a foundation plate built in the vessel, and the gag pins will be fitted in holes to the cast-steel quadrants.

In each pilot house will be placed a 36-inch steam-steering wheel and a 66-inch hand wheel. The two wheels will turn together, or may be disconnected below if desired. At each end of the vessel folding wrought-iron gates will be attached to cast-iron gate posts. Twenty brass-framed sidelights will be fitted in the hull.

CARPENTER WORK.

The main decks will be 3 by 3-inch Oregon pine, fastened to the deck beams by 1-2-inch galvanized bolts. The main planksheer and the coaming around the center house will be of yellow pine. The rail is to be of white oak with T-bars 2 by 2 inches fastened on top. The fender around the vessel will be of yellow pine, 4 by 11

inches, faced with a white oak wearing piece 3 by 11 inches.

JOINER WORK.

The outside of the lower house will be staved with white pine to the height of the rail. Above the rail the white pine tongue and groove will run fore and aft. The inside of the lower house is to be paneled with burlap with oak trimmings. The center house will also be paneled with burlap with oak trimmings and will be efficiently insulated. The outside of the upper house is to be staved with white pine to the under side of the windows, and above that point to be paneled. Above the seats in the upper house will be panels of burlap with oak trimmings. All window frames, doors, and seats will be of oak. The upper deck, which is to extend between pilot houses to the sides of the vessel, will be white pine tongue and groove covered with canvas and painted. The commissioner's room on the upper deck is to contain a large upholstered seat and a swinging table.

On the lower deck on one side will be the women's toilet, and on the opposite side will be the men's toilet in addition to a brig and a sick-bay containing four permanent berths. In the hold will be berths for 8 men. The entire upper deck to be enclosed by wire mesh fitted to a hard-wood railing.

MACHINERY.

The vessel will be propelled by a compound surface-condensing engine. The diameters of the cylinders will be 18 and 36 inches with a common stroke of 24 inches. The high-pressure cylinder will have piston valve and the low-pressure one double-port slide valve. The Stephenson link type of valve gear will be used. The crank shafts will be of the built-up type, and the thrust bearings of the horseshoe type with collars of cast iron faced with brass. The condenser will be rectangular, of cast iron, and will contain 950 square feet of condensing surface. There will be one centrifugal circulating pump, one vertical twin-cylinder air pump, one vertical duplex brass-lined feed pump, one horizontal duplex brass-lined fire pump, and one horizontal duplex sanitary pump. The propellers are to be of cast iron, 7 feet in diameter.

There will be two single-end Scotch boilers, 10 feet in diameter and 12 feet in length, to be constructed in accordance with the United States Inspection requirements for a working pressure of 135 pounds. Each boiler will have two furnaces, of the Brown latest type, connected to a single combustion chamber. The grate surface of the two boilers is to be 82 square feet, with grate bars 6 feet 6 inches long. The heating surface in the two boilers will be about 2,280 square feet.

The vessel throughout will be lighted by electricity and heated by steam.

New Marine Railway.—A new composite steel marine railway dry-dock of 3,000 tons capacity, for Hall Brothers, Port Blakely, Wash., has just been completed. The engineers and contractors for the work were H. I. Crandall and Son Company, 102 Border street, East Boston, Mass.

NAME—	NATIONALITY—American.	TYPE—Harbor propeller ferryboat.
LAUNCHED—	BUILDER—Harlan and Hollingsworth Company.	OWNER—Dept. Commerce & Labor.
Length over all.....	160 ft.	Cylinder diams.....18 and 36 ins.
“ “ stern posts.....	154 “	Stroke.....24 “
Beam at deck.....	37 “	Valves.....piston on H. P.; slide on L. P.
“ over guards.....	45 “	I. H. P., designed.....450
Crown of deck beams.....	6 ins. in 45 “	Rev, “.....120
Depth at center.....	15 ft. 3 ins.	Speed, “.....10.3 knots
Draft.....	9 “ 3 “	Condenser surf.....950 sq. ft.
Displacement.....	660 tons	Boilers: Number.....two single-end Scotch
Block coef.....	.43	Diameter.....10 ft.
Engines: Number.....	1	Length.....12 “
Type.....	compound	G. S. total.....82 sq. ft.
		H. S. “.....2 280 “

REMARKABLE RUN OF THE KEARSARGE
ACROSS THE ATLANTIC.

That the accredited trial speed of warships is fictitious, so far as that to be attained under service conditions, has more or less been generally assumed, but in the American Navy some most brilliant exceptions to this statement have been made, such as the world-famous trip of the *Oregon*, to show that the trial speeds obtained on our ships are not only within the province of possibilities, but that they may be actually secured.

The most recent and, in a way, remarkable of the long fast runs of our warships was performed by the U. S. battleship *Kearsarge*. She left Portsmouth, England, on July 17, passing The Needles, the point of departure, at 1:30 P.M., Greenwich time, and arrived at Frenchman's bay, on the coast of Maine, at 12:45 P.M. on July 26. The distance covered by the ship was 2,885 nautical miles, and the time, 219 hours 30 minutes,

to see a ship's length ahead. After running out of the fog, strong adverse currents were encountered for most of the run, it being estimated that on one day this head current amounted to 23 miles.

In commenting upon the results of the run, it should be borne in mind that the *Kearsarge* had been in active service for 44 days previously, having steamed in this time 5,000 miles. Twenty-three days had been spent in steaming, 4 days were occupied by coaling, and the remaining days, while in port, the ship was practically open to inspection to all visitors, and the officers and men were offered entertainment by first the German and later the English navies. All spare moments were spent in making necessary repairs, and when the *Kearsarge* sailed on her homeward voyage the *personnel* was not in the best of physical condition.

The *Kearsarge* is a battleship of 11,525 tons trial displacement. She has two sets of vertical, triple-expansion

TABLE OF PERFORMANCES OF H. M. S. GOOD HOPE, U. S. S. COLUMBIA, AND U. S. S. KEARSARGE.

	H. M. S. Good Hope, Nov. 25-Dec. 26, 1902.				U. S. S. Columbia, July 26-Aug. 2, 1895.		U. S. S. Kearsarge, July 17-26, 1903.
	Best day's run.	Portsmouth to Port Said.	Suez to Zanzibar.	Zanzibar to Durban.	Best day's run.	Southampton to New York.	Avg., Needles to Frenchman's Bay, Me.
Total knots run.....	....	2,905	2,849	1,590	....	3,090	2,885
Day's run, knots.....	440	376	401	356.5	462	442	314.4
Speed, average knots per hour... ..	18.8	15.7	16.7	14.85	19.25	18.41	13.1
Days, straightaway .....	....	7.73	7.1	4.46	....	6.98	9.15
I. H. P., main engines.....	10,639	10,175	8,571	6,600	10,554	9,576	5,205
" aux. machinery.....	....	....	....	....	..	140	184
Tons of coal per day, all purposes....	282	221	254	178	230	212	125.5
Tons of coal per day for auxiliaries...		....	....	....	....	11.33	..
Pounds of coal per I. H. P. per hour, main engines.....	2.3	2.31	2.59	2.34	1.93	1.95	....
Pounds of coal per I. H. P. per hour for all purposes.....	2.48	2.55	2.69	2.74	2.03	2.07	2.17
Distance run per ton of coal, knots...	1.56	1.70	1.58	2	2	2.08	2.47
Pounds of coal consumed per knot run.....	1,435	1,316	1,419	1,119	1,115	1,074	891
Pounds of coal used per ton of displacement.....	2.38	2.24	2.42	1.90	3.6	3.5	.918
Estimated relative coal consumption per 1,000 tons displacement at 10 knots	D $\frac{3}{4}$ S $\frac{3}{4}$		9.49	....		8.98	

giving a corrected average speed of 13.1 knots for the total run. This run was made under natural draft and accomplished in the face of head winds and head seas, icebergs, dense fog, and a gale. It is probable that, had the ship been going eastward under similar conditions, she would have averaged a speed of 14 knots, for by careful standardization of the screws the revolutions on this voyage should have given her a speed of 13.6 knots.

The only incident in the engine room of any kind was that, shortly after leaving, the wrist pin on the high-pressure port engine became heated, owing to an oiling tube clogging up. The bearing was quickly cooled down and no damage resulted. Head winds varying from 3 to 6 miles were encountered on seven of the days, and on another day a gale washed the seas over the forward 8-inch turrets, necessitating slowing down to about 10 knots for 4 hours. While off the Banks, on account of the presence of icebergs, the speed had to again be cut down to 10 knots for a period of 10 1-2 hours. The presence of the bergs was detected by the drop in the temperature of the water when the weather was foggy, for it was impossible during a greater part of the time

engines, the diameter of the cylinders being 33 1-2, 51, and 78 inches and the common stroke 48 inches. Steam is supplied by 3 double-end and 2 single-end cylindrical

GENERAL FEATURES OF THE THREE SHIPS.

	H. M. S. Good Hope.	U. S. S. Columbia.	U. S. S. Kearsarge.
Displacement, tons.	14,100	7,350	12,700
Length.....	500	411.5	360
Breadth (load line).	71	58.3	72.4
Draft, mean.....	26.5	22.4	25.5

TRIAL FIGURES.

Knots speed.....	23.05	22.8	16.8
R. P. M.	122.4	131.72	
I. H. P.	31,088	18,509	10,000
Pressure.....		145	
Boilers.....	43 Belleville	8 D. 2 S. Scotch	3 D. 2 S. Scotch
Boilers in use	27	all	all

boilers with a total grate surface of 685 square feet and a total heating surface of 22,104 square feet. On trial under forced draft the speed attained was 16.8 knots and the horse power developed 10,000. The total weight of machinery is 1,195 tons.

When starting out from Portsmouth she had a displacement of 13,406 tons, and when she dropped anchor in Frenchman's bay her displacement was but 11,995

tons, and the mean draft for the voyage was 25 feet 6 1-4 inches. Fifteen hundred tons of coal were stored in the bunkers and 125 tons in the superstructure on deck. Fifty-five thousand gallons of fresh water were

the end of this successful run was cleaning the furnaces and combustion chambers and repacking a few of the main valve stems and the high and intermediate piston rods.



FIRST-CLASS BATTLESHIP KEARSARGE, WHICH RECENTLY MADE A RECORD RUN FOR BATTLESHIPS ACROSS THE ATLANTIC.

[Photograph copyright, 1902, by E. Muller.

carried for making up feed water, in the four double-bottom compartments under the boiler rooms. Thus steam was saved which would otherwise have been required to run the evaporators.

The only overhauling of machinery made necessary at

In the June number of MARINE ENGINEERING was given a synopsis of the trials of the U. S. S. *Columbia* and H. M. S. *Good Hope*, showing in what particulars *Columbia's* transatlantic record voyage exceeded the trip of the *Good Hope* from Portsmouth to Durban.

We herewith reproduce the table and add the data taken on this voyage of the U. S. S. *Kearsarge*. It should be borne in mind that the three vessels are of different classes—commerce destroyer, armored cruiser, and battleship.

The length of the first two runs of the *Good Hope* and that of the *Columbia* were about the same as that of the *Kearsarge*. Although the speed of the *Kearsarge* was much less than the other boats, yet the horse power developed was more than 50 per cent. of the trial indicated horse power under forced draft conditions, while that of the *Good Hope* averages about 25 per cent. of trial conditions.

The coal consumed per I. H. P. per hour of the *Kearsarge* was decidedly better than that of the *Good Hope* on any of the three runs, and was within 0.1 of a pound to that of the *Columbia*.

As might be expected, the distance run per ton of coal going at a slower speed shows up favorably for the *Kearsarge*, as well as the other ratios, considering speed and displacement.

Further average results obtained on the *Kearsarge* are as follows:

Revolutions	87 1-2
Steam pressure at engines....	124 lbs.
Vacuum, mean	25.4 ins.
Cut-off H. P. cylinder.....	.62 stb.; .64 port
“ I. P. “	.66 “ .68 “
“ L. P. “	.7 “ .7 “
I. H. P., main engines.....	2,676 stb.; 2,515 port
Auxiliaries	184
Total of machinery.....	5,375
Coal, quality best Cardiff.	
“ pounds per hour.....	11,668
Heating surface	22,104 sq. ft.
Grate surface	685 “
Cooling surface	14,100 “
H. S. ÷ G. S.	32.27
I. H. P. ÷ G. S.	7.85
H. S. ÷ I. H. P.	4.12
Coal, pounds per hour per	
I. H. P.	2.17
Coal, pounds per hour per sq.	
ft. H. S.	.52
Coal, pounds per hour per sq.	
ft. G. S.	17
Speed of ship throughout voy-	
age	13.1 knots
Slip of propeller.....	9.3
Maximum for two hours—	
I. H. P.	7,026
Maximum for two hours—	
revolutions	97 1-4
Maximum for two hours—	
speed	14.9 knots

Unfortunately at the present writing it is impossible to ascertain the exact number of men engaged in the fire and engine rooms under Lieutenant-Commander Zane, chief engineer.

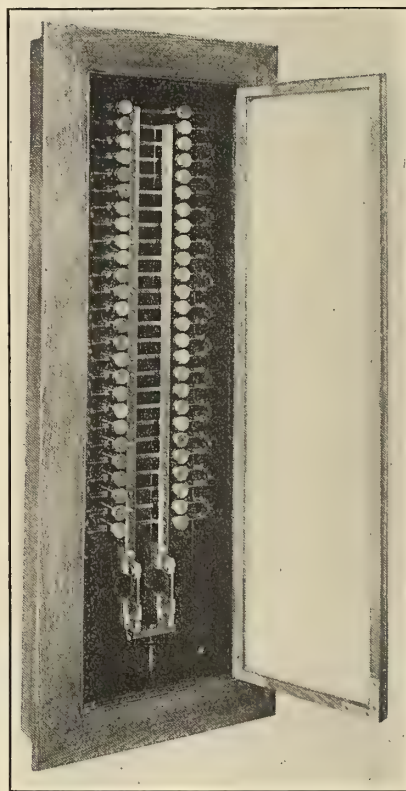
From Captain Hemphill down, all officers and crew are to be congratulated. The *Kearsarge* was built by the Newport News Shipbuilding and Dry-Dock Company.

USES OF ELECTRICITY ON BOARD SHIP.—III.

BY J. W. KELLOGG.

FITTINGS.

For merchant work on the sub-circuits that lead from the distribution points, joints are made where the wires are led off to the individual lights. No. 14 B. and S. wire is generally used for these branch circuits, and joints are made by stripping the wire from 1 1/2 to 2 inches, scraping it clean and soldering after the wires are twisted together. Rosin should be used as a flux, and not acid. It is possible to use acid and get good results.



26-CIRCUIT, 2-WIRE MAIN, WITH 2-WIRE DOUBLE BRANCH CABINET PANEL.

but the slightest careless work will make the joints liable to corrode, and it is generally found that if acid is used the wire is eaten away at the joints and there is continual trouble in the circuits.

After the joint is soldered it is taped up with rubber tape. If the location is damp and lead-covered cables are used, a sleeve of lead is wrapped over the soldered and taped joint. For heavy circuits, where it is necessary to divide or to splice, it is generally better to use a lug, in which the two ends of the cable are soldered, and then the whole taped up as before.

Up to a very few years ago it was customary to run most of the conductors in soft pine wooden moldings. If the wire was located in a damp place lead-covered cables were used. In the English-built ships it has been customary to run the lead-covered cables without any protection along bulkheads and fastened up by wires and cleats. For some ships in this country heavy cables have been led through insulators and through the angles of the frames. At the points where they pass through

these frames either hard rubber or porcelain bushings were used as a protection to the cables. In exposed places the cables were covered with sheet metal ducts, but generally the wires are simply left uncovered, with the rubber insulation and heavy braid as protection.

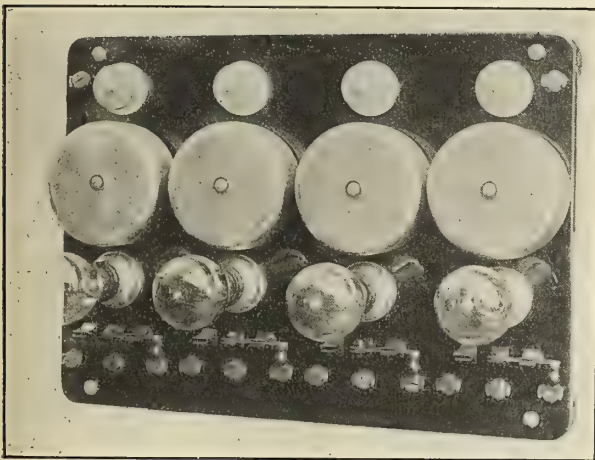
Too much care cannot be given to the insulation of the wires to be used on shipboard. The Navy standard requirements are none too good for any of the merchant vessels. The copper conductors are covered first with a layer of pure Para rubber, then a layer of vulcanized rubber containing at least 30 per cent. of pure rubber, and a heavy coating braid placed over this.

It is customary now in all classes of insulation on shipboard to install a large amount of conduit, either steel or iron tubing, through which the conductors for carrying the electric current are drawn. The wires are thus protected from mechanical injury, and if the joints in the piping are properly made the system is water-

Incandescent lights are usually from 10 to 32 candle power, the great majority being 16 candle power. What is known as low-economy lamps are generally installed, as the filaments are more substantial and the efficiency is not of as much importance as the life of the lamp. Lamps from 3.4 to 3.8 watts per candle should be used.

SPECIAL LAMPS AND FITTINGS.

In some of the engine rooms arc lamps may be employed to good advantage. These should be of the enclosed type, for use on the incandescent circuits, and



RUNNING LIGHT TELLTALE.

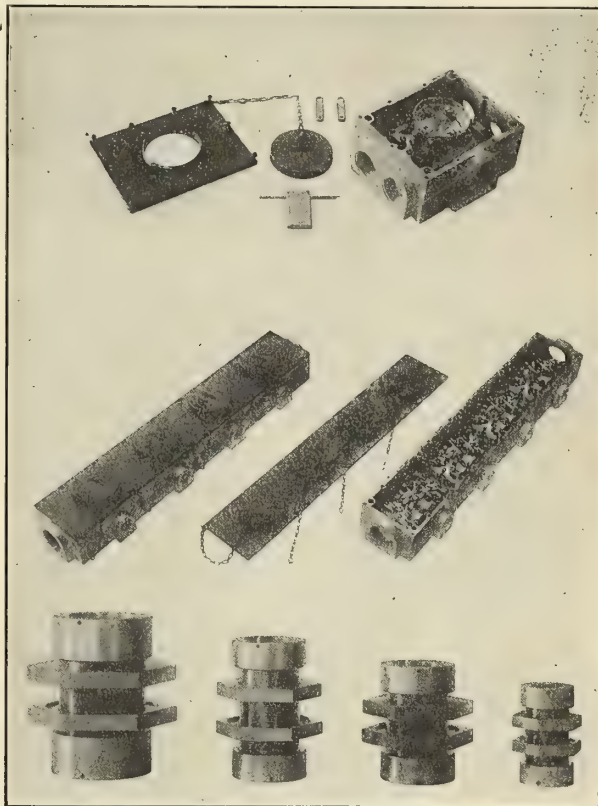
tight, and there should be practically no deterioration of the cables due to sweating.

CUT-OUTS, SWITCHBOARDS, AND LAMPS.

For merchant work the ordinary commercial porcelain cut-outs are largely used, though there is a tendency to use specially-constructed panels which have the conductors mounted on one slate panel, and the circuits led off from the main conductors through fuses that are mounted directly on these slates.

Enclosed fuses are being used at the present time, although until very recently open fuses protected by mica covers were used. For fuses of large carrying capacity, strips of zinc are employed; small fuses are of lead wires. The switches on the distribution boards are usually of small snap rotating type, but with the specially constructed panels, having the copper bars mounted directly on slate, small knife switches with fuse terminals are used.

On the main switchboards, which are usually of slate or marble, bus bars are mounted on the back, to which the main generator cables are connected, and from which connections are made to knife switches and to fuse terminals on the face of the board. The mains and branches are led from these circuit switches.



SMALL FITTINGS.

Three-way Feed Junction Box, Fused. Eight-way Marine Distribution Box Stuffing Tubes.

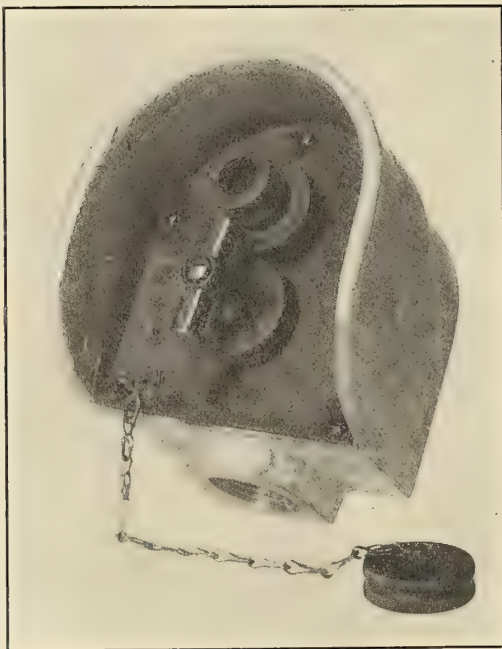
are special marine type lamps, constructed with outer globes protected by wire screens and with the casings practically water-proof. These hung over the cylinders in the engine spaces give a good general illumination in engine rooms. The running lights are usually supplied with two lamps in each lantern, the focus of the Fresnel lens being the point at which the center of the lamp is placed. Small lamps of 4 candle power are supplied for the compasses, being arranged in a socket so as to be placed in the side of the binnacle casing.

In the freight spaces and in the engine and fire rooms and shaft alley it is usual to install water-proof fittings with steam-tight globes over the fixtures. In cargo spaces it is customary to use a large reflector having four or five lamps arranged in a cluster and protected by a heavy wire screen. These have portable cords attached with plugs on the ends, which can be inserted in receptacles that are located outside of the cargo spaces. When the hatches are closed and it is not desired to use

the lights in these spaces, current is entirely shut off from them.

ELECTRICALLY-DRIVEN AUXILIARIES.

Regarding the motors for auxiliaries, about the first application on shipboard was for operating the valve of the steam-steering engine. This was about as difficult an undertaking as any that could be thought of. The requirements, although calling for small current, nevertheless necessitate some means of making and breaking contacts almost continuously without injury to the contacts. It is also necessary to make a follow-up device, so that the location of the rudder is indicated by the position of the handle controlling the motor on the valve. In spite of the difficulties encountered this was very successfully worked out and a large number have been installed.



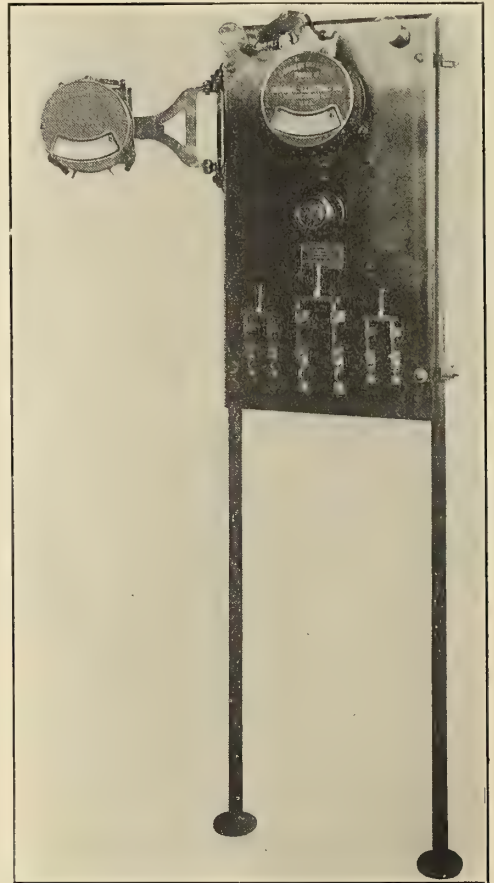
FIVE-AMPERE MARINE SWITCH AND RECEPTACLE IN BOX WITH HOOD.

Electricity lends itself very readily to the driving of blowers for hull ventilation. The leads of steam piping into the living spaces are avoided, making it much easier to cool and ventilate. It is the universal practice now to operate the ventilating system by means of electric-driven fans; the fan mounted directly on the extended motor shaft, both being carried on one foundation, making a rigid structure easy of operation, with very little possibility for wear, requiring practically no attention when properly installed.

CARGO WINCHES.

For the cargo winches there have been a few installations in which electric motors have been used. For this purpose the electric motor is also especially fitted. Winches are usually located where, if they are to be steam driven, it is necessary to carry steam pipes throughout the length and breadth of the ship. These winches are used intermittently, and when not in operation it is supposed that steam would be shut off from

the pipes leading to the different winches. It is well known that when steam is again turned on, the pipes are found to be leaky, and it is almost impossible to keep them tight; much damage results to the cargo and the spaces are heated unduly. With the electric motor the steam is all confined to the main generating station; there is no deterioration of the conductors, whether the current is on or off; there is no heating and no waste from radiation in the steam pipes extending over long distances; and it is a fact that electric winches, as constructed to-day, are operated with the greatest ease.

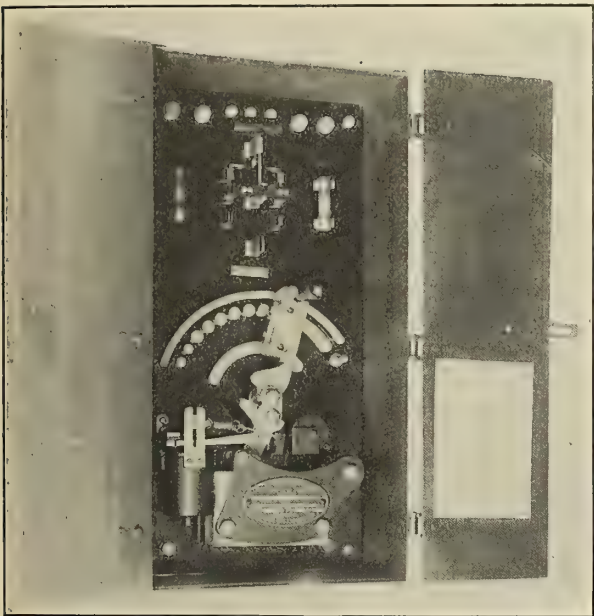


SMALL PLANT SWITCHBOARD PANEL.

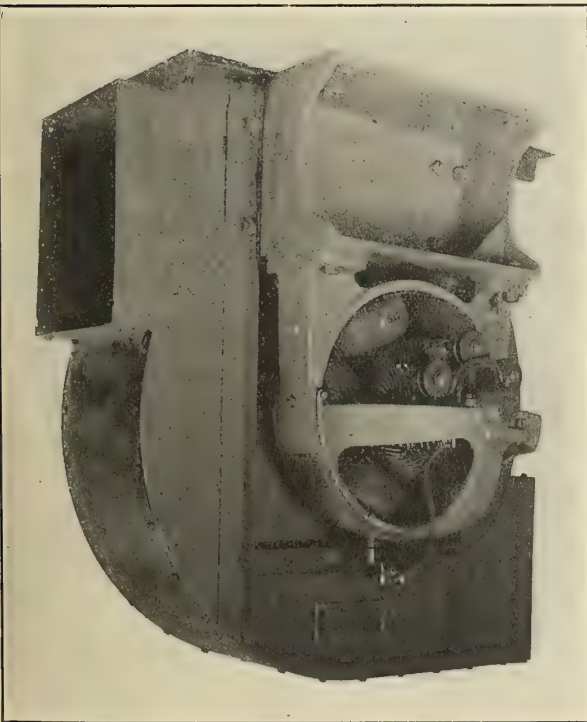
WINDLASS.

For operating the windlass I believe there have only been two applications, and those in the case of small yachts. Here is a case where the electric motor could be installed to the very best advantage. In any ship's plant there is always sufficient reserve capacity that could be called upon when it was desired to operate the windlass. This occurs very infrequently, and an entirely enclosed water-proof motor, mounted on the bed of the windlass—on the same base, as with a steam engine—could be relied upon to perform its work under all conditions, with the assurance that it would always be ready when wanted. By having the generator for driving the windlass arranged so that only a certain amount of current could be supplied, the motor would operate

without bringing any undue strain upon the mechanical parts of the windlass or the chain, and would automatically respond to any increased or decreased load brought upon it.



MOTOR-CONTROLLING PANEL FOR THE U. S. S. DENVER.



SIX AND ONE-HALF HORSE-POWER, 80 VOLT, VARIABLE-SPEED MOTOR, DIRECT-CONNECTED TO A 55-INCH STEEL PLATE FAN, ON U. S. S. FLORIDA.

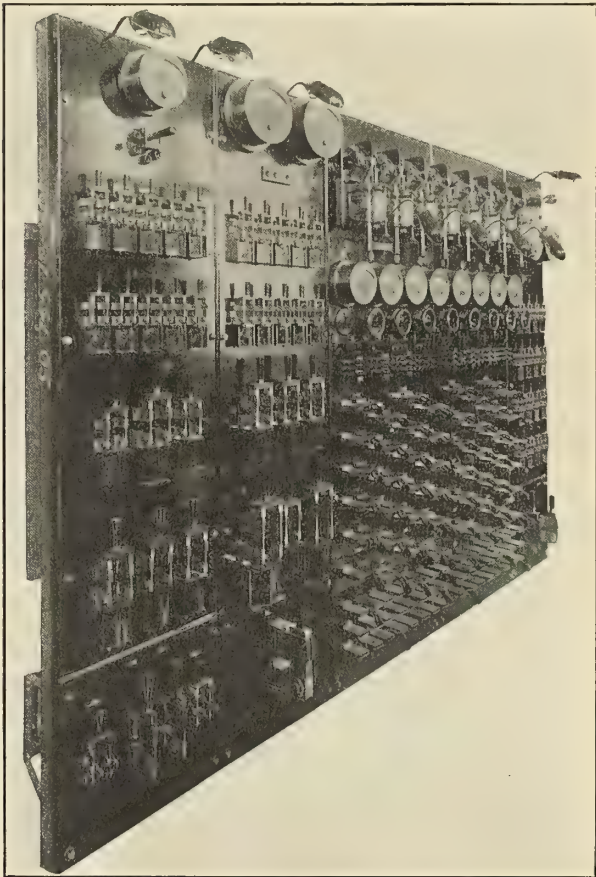
Bilge pumps have been supplied on some few ships, but thus far the engine-room auxiliaries have never been equipped electrically. There is a good field for the electric drive even here, as motors could be operated under all conditions of load and could be connected to

feed pumps, circulating pumps, forced-draft blowers, air pumps, etc., with the assurance that the system would prove satisfactory.

It is confidently believed that with the introduction of the steam turbine for driving the electric generators, thus enabling a very large plant to be installed in a small space with very little added weight and at a comparatively low cost, it will be found very convenient to call upon a central electric plant for all auxiliary purposes on shipboard.

STORAGE BATTERIES.

On board steam yachts, where light is needed at all times of night, but where cruising is usually done only



PANELS FOR THE U. S. S. MISSOURI.

in the daytime, and thus the engineers are off duty at night, it is desirable to install a storage battery in addition to the generator. Many yachts have been equipped with storage batteries, another desirable feature of them being that at night-time, when the batteries carry the load, there is no noise of a steam engine of the generating set to disturb the sleep of the owner.

The batteries in use in this country are of the chloride type, as made by the Electric Storage Battery Company, or by other concerns having some modifications in their plates, but the general style of the battery is the same. The elements are made of lead plates, in which spaces are left for the placing of lead salt, which is reduced electro-chemically to pure metallic lead; the plate is thus finally composed of pure metallic lead. Diluted

sulphuric acid is used in the cells, having specific gravity of 33 degree Beaumé—a good commercial acid of 66 degrees Beaumé, one part of acid by volume being added to three parts of water. The solution must be cold when poured into the jars with the elements, and the acid should be poured into the water in mixing. Batteries are arranged with a number of cells connected in series, the cells usually mounted in a box, lead lined, and carefully insulated from the hull of the ship.

Covers are provided for the cells, to prevent the acid from flying out, due to the movements of the ship; but there is always more or less slashing, and it is desirable to keep the cells in a compartment where they can be installed in such a way as to be easily gotten at, and where any fumes that may arise can be carried off without penetrating to the other parts of the ship. It is usually customary to charge the battery at such times as the light is not being used. The battery may be connected to the generator through a switch, which, when thrown in opposite direction, connects to the lines. The charging should be carried on at about a constant current; to maintain this the voltage will have to be varied from about 1.7 volts per cell to 2.8. The cells should not be discharged below about 1.8 to 2 volts per cell.

(To be continued.)

Lining Up Shafting.

A correspondent of *Power* recommends the following method of lining up a marine shaft:

A 1-16-inch hole is drilled through forward engine-room bulkhead; hole in stern post bridged and a 1-16-inch hole drilled through bridge, both drilled holes to correspond with shaft center. A light is then placed forward of engine-room bulkhead hole and it can easily be seen through these two 1-16-inch holes. After-tank bulkhead hole is then bridged, a 1-16-inch hole drilled through bridge and bridge adjusted so the light can be seen through these three 1-16-inch holes. Circles can now be described around these holes in the stern post and after-tank bulkhead with the 1-16-inch holes for centers, bridges removed, and boring bar set by circles. Of course any number of intermediates may be erected before bridges are taken out, to get height of seatings, chucks, etc. All errors of a sagging line are thus avoided.

To line from tail-shaft coupling, shaft-alley bearings, of which there is often only one for each section of shafting, are not used. Each length of shafting is blocked on two blocks in such a way that the overhanging ends balance the portion between blocks, otherwise the shaft will sag, throwing couplings out. Faces of couplings are left a little apart for lining up, so a very keen taper wedge can be used between them. If now the after coupling of after line shaft section is central with forward coupling of tail shaft and the taper wedge enters the same distance all around between their faces, tail shaft and after section of line shaft are surely in line, and the next length forward may be proceeded with. When all the shafting is in, engine bed with crank shaft in place is set in the same way, and forward crank-shaft center will correspond with the 1-16-inch hole drilled in forward engine-room bulkhead. Before blocks are removed from under line shaft, shaft-alley bearings are put in place.

X.

STEEL TOWBOAT SPRAGUE.

The largest and most powerful towboat ever built for the Mississippi river was recently turned out from the yards of the Iowa Iron Works Company, Dubuque, Iowa, to the order of the Monongahela River Consolidated Coal and Coke Company, Pittsburg, for use in taking down river the immense fleets of coal barges. The *Sprague* is, as seen in the illustration, of the usual stern-wheel type of steamer which predominates on our Western rivers, but her size is very much larger than any boats yet built, her over-all length being no less than 318 feet. The hull is built of steel from the boiler deck down, the general dimensions being as follows: length of deck, 277 feet; beam, molded, 61 feet; beam over guards, 64 feet 8 inches; depth, molded, 7 feet.

To give sufficient strength to this lengthy and very shallow vessel 3 fore-and-aft bulkheads are fitted, and a system of hog chains and braces is built to take up the strains due to the heavy weights resulting from placing the boilers forward and the engines aft. The hog-chain braces are 4 in number on each side of the vessel and rest upon footlands or steps made up of plate and angle securely riveted to the frames. The general arrangement of the hog chains and braces is shown on the drawings on pages 478 and 479. The chains are well secured to the hull, one set of chains also extending to the end of wheel brackets.

CABIN.

On the cabin deck the officers' quarters occupy the space forward from the forward side of the pilot house. They comprise a large hallway, about 18 feet in width, running the full length thereof, and on either side thereof are the various state rooms and captain's office. Each state room is fitted up with a double berth, one above the other, with clothes rack and washstand, and two doors lead from each state room, one into the main cabin and the other on deck. Immediately aft of the officers' quarters, and on one side of the vessel, are the officers' wash room, bath rooms, lavatories, etc., and on the other side are the kitchen and pantries. Aft of the kitchen is a hallway running crosswise of the vessel, and aft of this hallway are located the two large cold-storage rooms. The after part of the cabin is divided into three large compartments fitted up with berths for deck hands and roustabouts. Washstand, bath room, and lavatory are fitted for the use of these men. All the rooms are lighted with electric lights, and hot and cold water is supplied to all bath rooms. The pilot house, as shown in picture, is located above the cabins. It is about 20 feet square. The wheel is 13 feet 6 inches diameter.

Following will be found specifications covering the principal items:

Hull Construction.—The floors are 57 feet long with a radius of knuckle 15 inches and a side-frame flare of 2 feet. The guards are 22 inches

Frames and Floors.—The side frames and floors are channels 6 inches by 15.3 pounds, in one length, spaced 18 inches centers face to face, except where the frames reverse face forming the after body.

Beams.—The deck beams are of 8-inch channels, 15 pounds weight per foot, secured to the frames by tri-

angular gusset plates 16 inches on the square. Where the boilers are supported there are in addition 8 I-beams, 8 inches by 20 pounds, put together with cast-iron separators. The boiler beams are 1 inch apart when framed. The bow beams are 8-inch I-beams.

Side Strakes.—These are of 8-pound T, secured to frames by clips. Two boiler bearers are placed forward for each boiler, 14 inches wide, 6 inches in the center of box, formed in length to suit the boiler.

Bulkheads.—There are 3 fore-and-aft and 9 thwartship bulkheads of 1-4-inch plate, stiffened by 2 by 3-inch by 5-pound vertical angles spaced 3 feet centers. The cross bulkheads are riveted to frames and beams, stiffened by angles of above dimension spaced 18 inches. The

inch by 7-pound angle and plate, from forward bulkhead to stem 5-16-inch, side plate 16 inches, and throat plate 24 inches wide, all secured to cant frames by triangular plate gussets 18 inches on square by 10 pounds.

Stem.—2 1-4 by 12-inch forged iron, about 30 feet long, and slotted to receive forward keel plate. The stem plate is of 5-16-inch plate to height of upper hook.

Spar Horse.—26 feet above deck; stock 12 by 12 inches at the deck and 10 by 12 inches at the top; head 8 feet long; two cross arms and two sets of braces.

Stern Posts.—Four stern posts, 2 by 8 inches, with rudder irons forged on same.

Transoms.—One main and one aft transom. The main transom 3 1-2 feet deep, 5-16 inch thick, in two



STEEL STERN-WHEEL TOWBOAT SPRAGUE, FOR THE COAL FLEETS ON THE OHIO AND MISSISSIPPI RIVERS.

center bulkhead runs to the stem, while the two wing bulkheads run from bulkhead No. 1 forward in line of capstans and extend to the top breast hook within four feet of the deck.

Footlands.—To have four footlands—steps for the hog-frame braces—between wing and center bulkheads, of 3-inch Z-bar 10 3-10 pounds, from bow to stem, secured from frame by 6-inch angle clip, with three rivets in each frame.

Wing Keelson and Stringer.—One wing keelson and one over keelson on each side, of double angles of 2 1-2 by 2 1-2 inches by 4 1/2 pounds. Stanchion on every beam 3 by 3 inches by 7 pounds, secured in root of Z-bar keelson and wing stringer, with two rivets each top and bottom.

Breast Hooks.—Two breast hooks of 2 1-2 by 3 1-2-

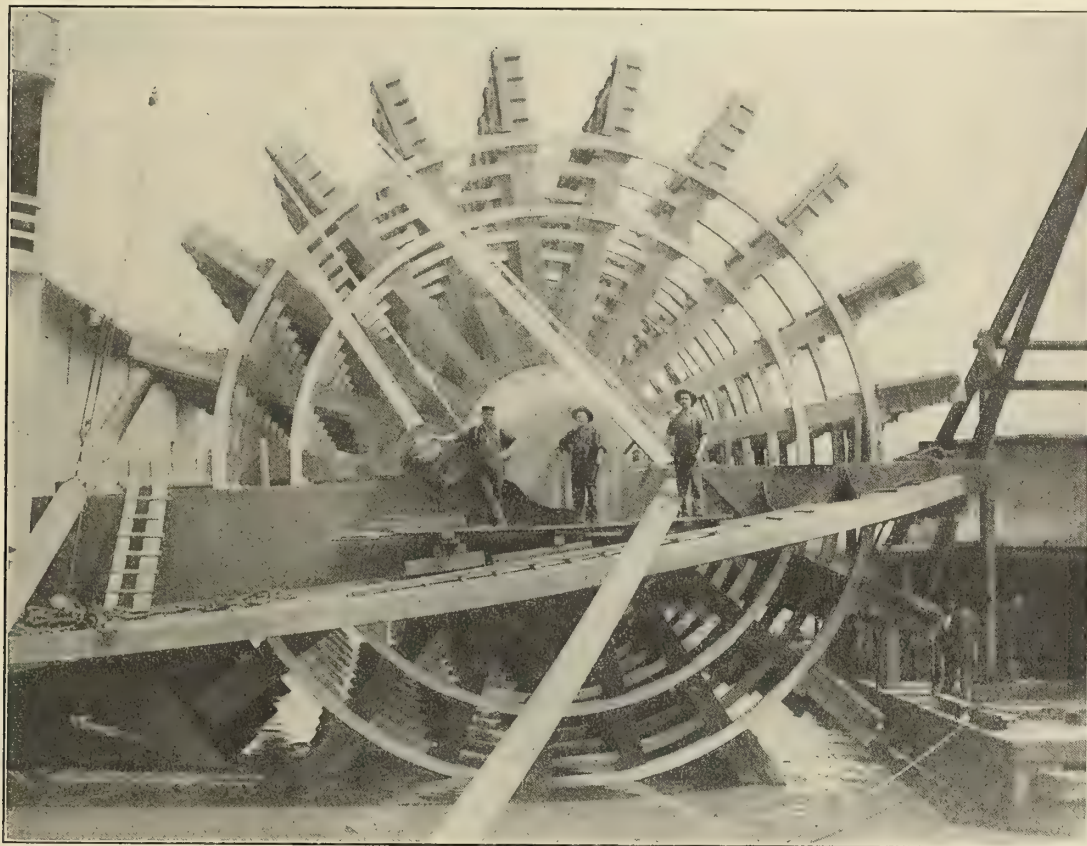
pieces, spliced by plate full width of transom and 4 feet long; stiffened by angles 3 1-2 by 5 inches by 15 pounds. After transom to be secured to main transom by four trapezoidal-shaped brackets of 3 by 3-inch by 6-pound angle and 5-16-inch plate, to form casing of the rudder posts, and carefully riveted to be absolutely water-tight. The stern posts secured to forward side of main transom by 3 by 3-inch by 8-pound angle, riveted to transom and through stern post as may be required, and supported by bulkhead running to forward end of engine beams, well braced.

Rudders.—Four balance rudders; stocks 16 inches diameter, double thick tubing; the blades constructed of 2 1-2 by 2 1-2-inch by 6-pound steel angle forming frame, with a channel beam shoe 6-inch by 10-pound channel, plated with 5-16-inch plate, and stiffened with flanged

under planksheer 10 inches 10 pounds, and on same a deck of 1-8-inch plate lapped in and out, and well riveted to the carlin.

Also, three cross bulkheads under large cylinder, one aft, one forward, and one in the middle, constructed of 2 1-2 by 2 1-2-inch by 5-pound angle and 1-4-inch plate; the top angle formed to shape of cylinder, the side bottom angle to conform to deck and web plates of beams, and to be properly staybolted through both webs and beams. Also, cylinder pans for after end of large cylinders of aft end of sides, constructed of 2 1-2 by

shaft. The high-pressure cylinders are 28 inches diameter and the low-pressure cylinders 63 inches, the common stroke being 12 feet. The pistons are of cast steel and the rods of hammered steel, 9 inches diameter for the high-pressure and 10 inches diameter for the low-pressure. The crossheads are of cast-steel with brass slippers, and the slides are of close-grained cast-iron. The pitmans, or connecting rods, are of white pine 54 feet long, with straps, gibs, guides, etc. The wheel shaft is of hollow forged nickel steel, the outside diameter being 31 inches; diameter of the hole, 21 inches at the center



STERN WHEEL OF STEAMER SPRAGUE, 40 FEET DIAMETER, BUCKETS 4 FEET WIDE BY 40 FEET LONG.

4-inch by 1-2-inch T-bar and 5-16-inch plate, stiffened at intervals of 4 feet, and secured to web by rivets and staybolts at intervals of 24 inches, zigzag; also three bulkheads at pillow blocks, one at center and one at each end of same; all bulkheads to be provided with smooth and neat manholes, so man or boy may enter. Also six latticed trusses over boilers, 24 inches at ends, 30 inches in the middle.

The siding, coal box, deck room, and engine room to be plate, 6 pounds, neatly riveted, with doors and windows where desired. Stern bulkhead to be of iron and not less than 3-16 inch thick, well stiffened with angle iron, and to run to top of boiler deck, and above boiler deck 1-8 inch thick.

MACHINERY.

The machinery consists of two tandem compound balanced poppet-valve lever engines with California cut-off, each engine working on a crank at the end of the

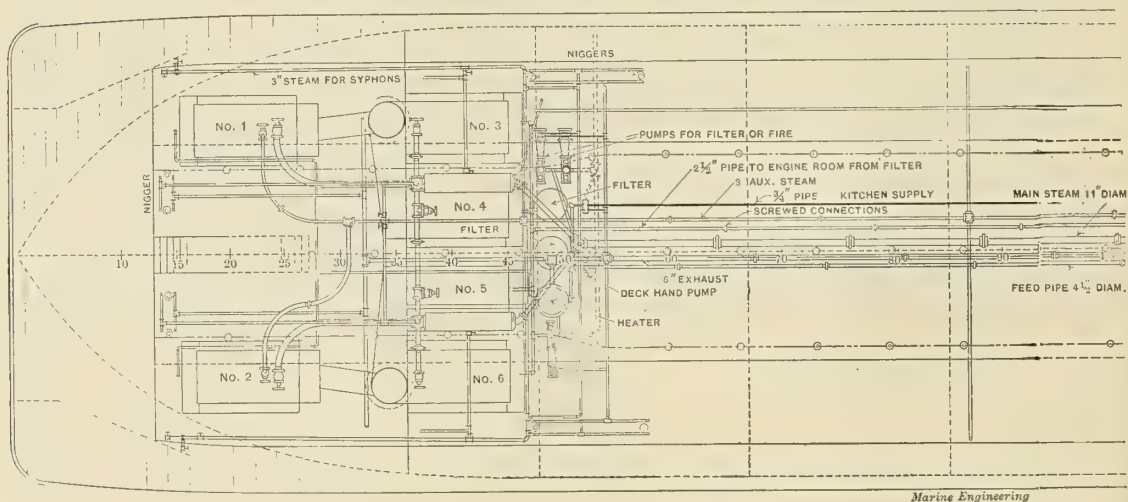
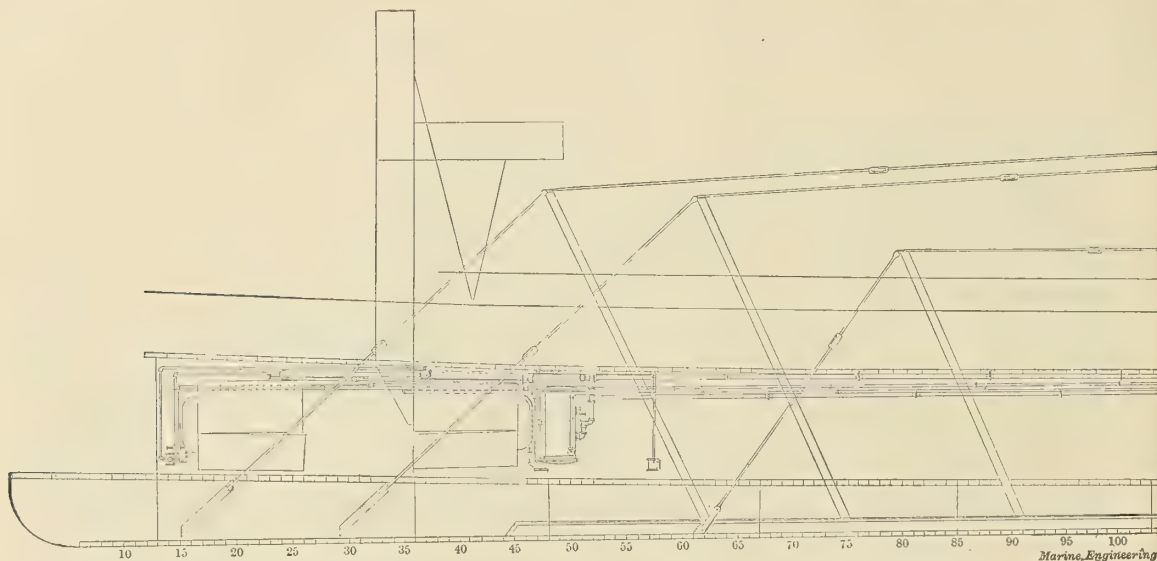
and 10 inches at the journal. The length of the shaft is 47 feet 2 inches, and its weight is 80,220 pounds. It is fitted with 8 cast-steel flanges, to which are attached the spokes of the wheel. The wheel is 40 feet in diameter, with 21 buckets 40 feet long by 4 feet wide. This immense wheel and shaft are well shown in the accompanying engraving.

There is a steam reversing engine with all shafts and levers complete. Water is supplied the boilers by two "doctors" having water plungers 7 inches diameter by 12 inches stroke, with air pump attached 27 inches diameter and 15 inches stroke. There are also two circulating pumps, a fire pump, deck pump, and siphon pumps to comply with the law. Each engine exhausts into a surface condenser, the cooling surface in each being 2,500 square feet. Completing the list of auxiliaries are: electric-lighting plant, complete refrigerating outfit, and steam-steering gear. For warping the ship, hand-

ling gangplanks, etc., there are 7 steam capstans with double 7 by 12-inch engines.

In order to pass under the bridges on the river, it is necessary to lower the smokestacks, so chimney hoists are arranged for this purpose. Each stack is in two sections, the upper section being hinged on the after side, so that it may be swung down.

ried to the main 11-inch line running aft a distance of 130 feet to the two 8-inch branches to high-pressure cylinders. The exhaust from the low-pressures leads diagonally forward through 18-inch lines to condensers; the pumps for same are on forward engine-room bulk-head. The feed pumps send the water forward through 4 1-2-inch feed line to the closed feed-water heater be-



PIPE PLAN AND HOG-CHAIN PLAN

PIPING.

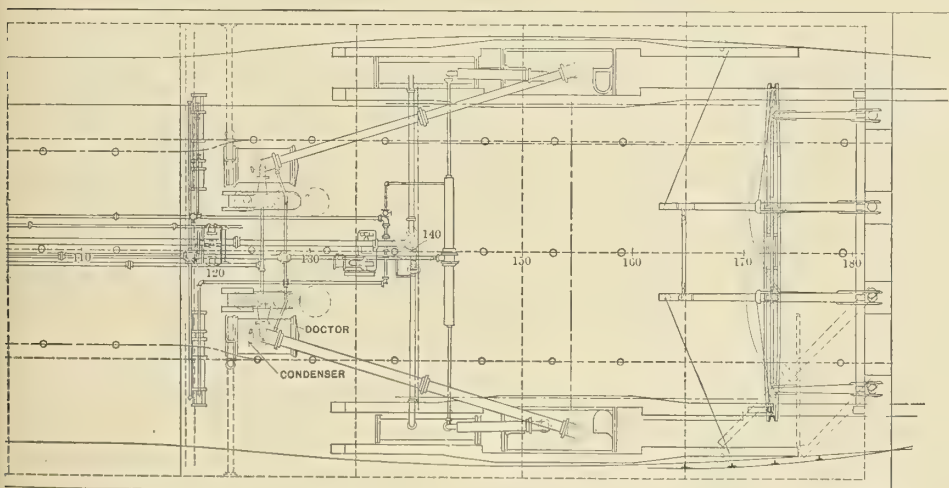
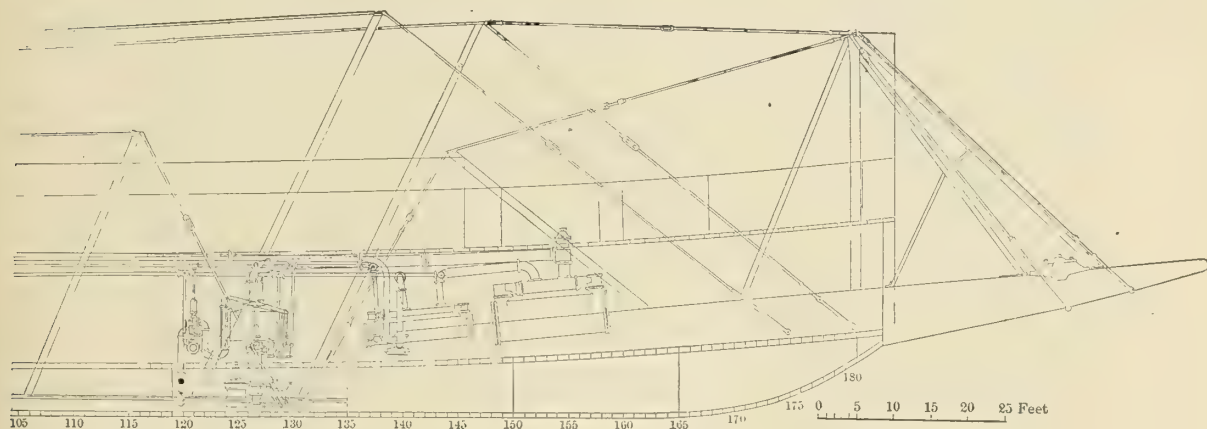
The piping is shown on the accompanying drawings. The main 6-inch steam pipe is taken off from each boiler to the 6-inch header above the four after boilers. Two steam drums are placed above these boilers between each pair, and through a cross is taken the steam from one forward boiler and two after boilers into each drum. It is thus seen that the size of the piping is held at a minimum. From each drum is led a 4-inch line for the fans and siphons, and niggerheads abreast of boilers, and in the after end of drums steam is car-

ried to the main 11-inch line running aft a distance of 130 feet to the two 8-inch branches to high-pressure cylinders. The exhaust from the low-pressures leads diagonally forward through 18-inch lines to condensers; the pumps for same are on forward engine-room bulk-head. The feed pumps send the water forward through 4 1-2-inch feed line to the closed feed-water heater be-

BOILERS.

The boilers, located at the bow, are 6 in number and are of the Hopkins type, as illustrated on page 480. They are equipped with induced draft, the engines and blowers for which were furnished by the American Blower Company. There are two 120-inch full-housed fans with top angular discharges. The wheels are 84 inches in diameter, 46 1-2 inches wide at the center and

horizontal tubular boiler and two fire chambers below, connected therewith, extending longitudinally with the boiler shell. These fire chambers or furnaces have each an annular water space, extending throughout the length of and surrounding the entire furnace. This annular water space surrounding the furnace is connected to the tubular member with water legs at the front and rear thereof, the front water leg being somewhat longer than



Marine Engineering

OF THE STEEL STERN-WHEEL TOWBOAT SPRAGUE.

34 3-8 inches at the periphery. Direct-connected to each of the fans is an 8 by 8-inch open-frame vertical engine.

The boiler contains many features of interest. First, it is evident that it is a cheaper form than the usual type of marine boiler, as it is without the expensive internal combustion chamber; also, the shell is small in diameter, and, therefore, can be made of light plates. It differs from the Continental type of boiler in that the combustion chambers are mounted in separate shells. As will be seen from the drawing, it is made up of one

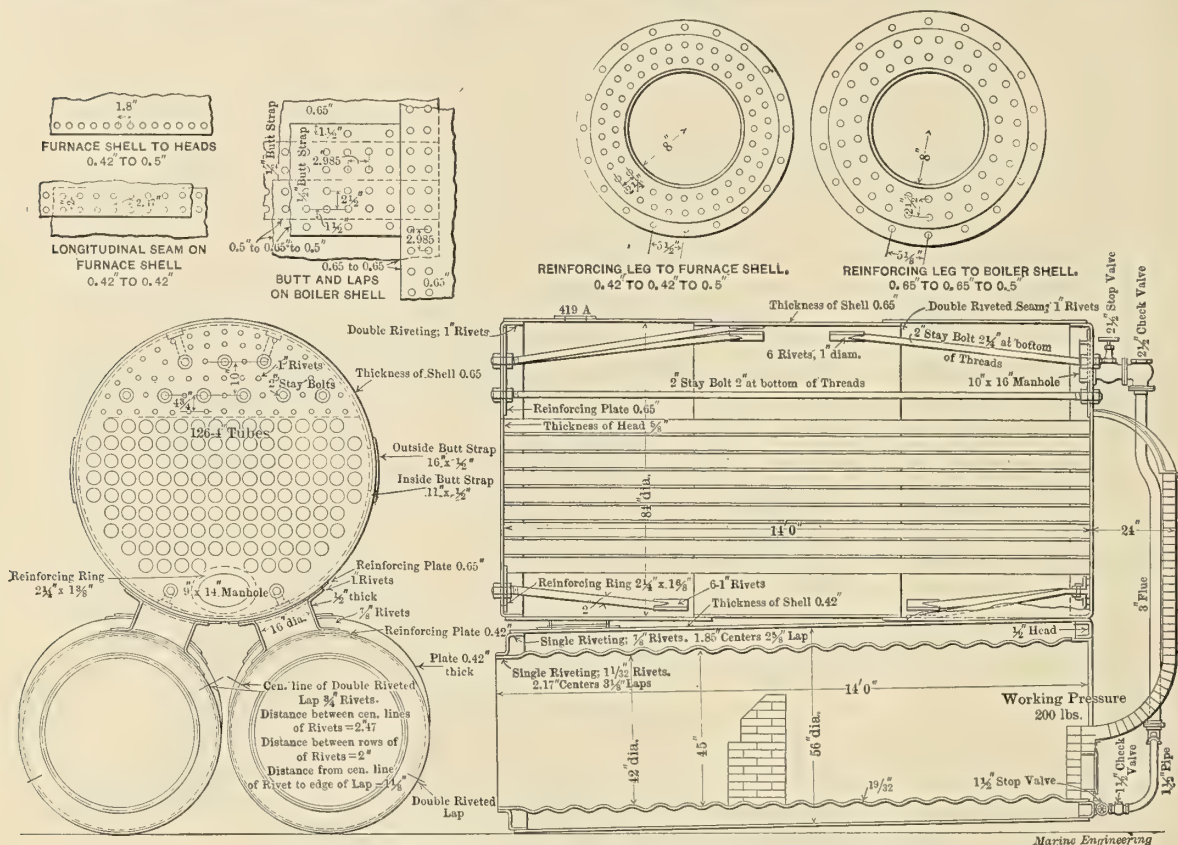
the rear water leg. The furnace used is of the corrugated type. In installing the boilers the tubular member is made level, and the furnace, because of the longer water leg in the front than in the rear, inclines upwardly from the front to the rear.

A sheet-iron combustion chamber lined with firebrick is attached to the rear of the boiler, and the feed-water pipe is carried through the combustion chamber and the rear head of the boiler and discharges the feed water over the smoke flues in the front of the tubular member. The feed-water pipe, before it enters the combustion

chamber, has connected to it laterals from each of the water spaces surrounding the furnace, these laterals coming from the bottom of the annular water space. Check valves are inserted in each of these laterals to keep the feed water from entering the annular water spaces.

The object in inclining the furnaces from the front to

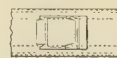
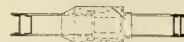
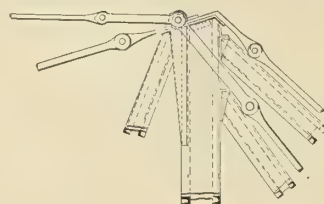
feed pipe, and discharged over the front leg. Especially is this the case when the feed pumps are not working. The boiler is provided with manholes in the tubular member, both above and below the smoke flues, and also with handholes for cleaning the annular water spaces surrounding the furnaces. Every part of the boiler is accessible for cleaning.



ONE OF THE SIX HOPKINS BOILERS INSTALLED ON THE STEAM TOWBOAT SPRAGUE.

the rear is to create a circulation of water through the boiler. The action of the boiler in operation is as follows:

The fire being started, the water surrounding the corrugated furnace becomes heated and travels along the annular water space until it reaches the back leg; thence it flows upwardly through the back leg into the tubular member, striking the smoke flues and back flue sheet of the tubular member, thence forward through the tubular member and down the front leg into the annular water space, the circulation of water being down the front leg, thence over the furnace, up the back leg into the tubular member. This circulation is also accelerated by having the feed water discharged in the front part of the tubular boiler directly over the front leg, and, as the tendency of the colder particles of water is to settle and the hot particles of water to rise, it results in the feed water being carried down the front leg into the annular water space surrounding the furnace. A circulation is also created by having the feed-water pipe pass through the combustion chamber, as in this manner the water is drawn from the annular water space below the furnace through the two lateral pipes, carried up the



Marine Engineering

DETAILS OF HOG-CHAIN BRACES AND HAWSER POST.

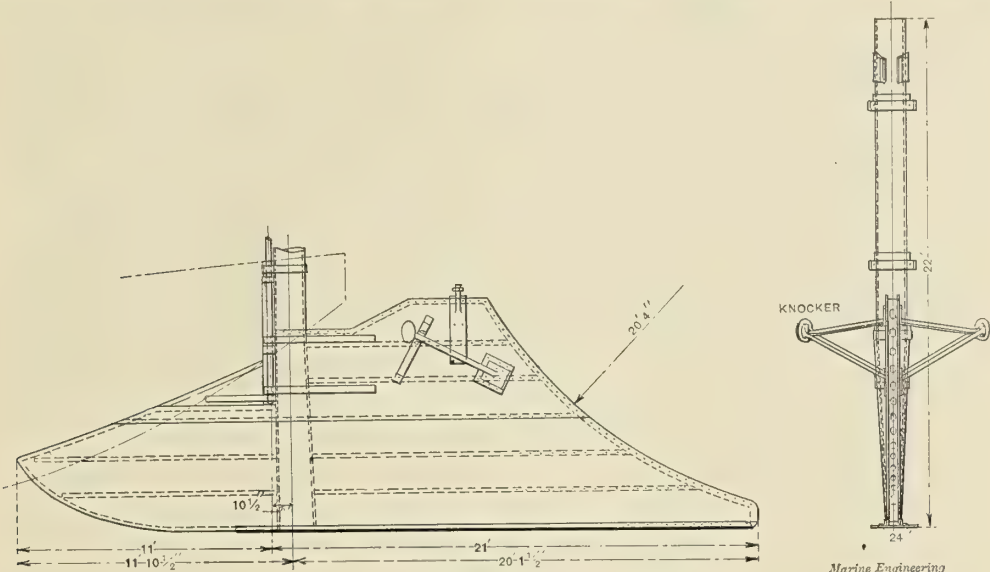
Two important features about the boiler are worthy of consideration.

1. The positive and uninterrupted circulation of the water, passing, as it does, down the front leg, thence

through the water spaces surrounding the furnaces, thence up the back leg and washing the back flue sheet and all the smoke flues connected therewith, thence washing along all the smoke flues through the tubular member, and down the front leg again. This circulation

keeps the boiler of an even temperature throughout, thus doing away with any unequal contraction or expansion, and the disastrous results caused therefrom.

2. The sediment which exists in all water is, in the Hopkins boiler, deposited in the tubular members below



ONE OF THE FOUR RUDDERS FITTED ON THE SPRAGUE.

Marine Engineering

NAME—Sprague.		TYPE—Western river towboat.	
LAUNCHED—1901.		OWNER—Monongahela River Consolidated Coal and Coke Co.	
NATIONALITY—American.			
BUILDER—Iowa Iron Works.			
Length over all.....		Revolutions.....	10
" on deck.....		Boilers: Number.....	6
Beam, molded.....		Type.....	Hopkins
Depth, ".....		Diam. of tube shell.....	7 ft.
Engines: Number.....		" furnace shells.....	4 " 8 ins.
Type .. tandem compound, poppet valve with California cut-off		Length of shells.....	14 "
Cylinder diams.....		Furnaces: Number.....	2 each
Stroke.....		Diam., mean.....	45 ins.
Rods.....		Length.....	14 ft.
Pitman (connecting rod) .. white pine,		Tubes: Number.....	126
length 54 ft.		Diam.....	4 ins.
Shaft, outside diam.....		G. S. per boiler.....	42 sq. ft.
" diam. hole.....		H. S. " ".....	2,000 " "
" length.....		G. S. total.....	252 "
Wheel: Diam.....		H. S. " ".....	12,000 "
Buckets.....		Coal per 24 hours, about.....	115,000 lbs.
" number.....		" " hour per sq ft. G. S.....	19.0 "

the smoke flues. As these parts are not subjected to the fierce heat of the furnace, there can be no bagging or burning of the shell. The sediment is always deposited in this spot because of the circulation which exists in the boiler, there being less disturbance in the water at this part than any other part of the boiler.

Two ash wells are placed in the ash pans of boilers, and consist of straight tubes running down through the bottom of the boat.

From the foregoing it is evident that the hull and machinery of this vessel are very heavy for such a shallow-draft boat. When light the boat draws about 6 feet at the wheel and 5 feet at the bow, and when loaded to push or tow she draws about 6 feet at the wheel and 7 feet 6 inches at the bow. Coal is placed upon the forward deck in order to bring the bow down to this draft, so that the towboat may handle the loaded barges going downstream. In going upstream she carries no load, in order that she may be properly hitched on to her empty barges.

The boilers carry 200 pounds of steam, and there is but very little drop in the long line to the engines. The owners of the boat, who have a fleet of about 80 vessels on the rivers, decided that a large and slow-running wheel was the best suited for this class of work, and therefore the wheel was made, as above stated, of such great diameter and with such large buckets. This cut down the revolutions to about 10 per minute. It is stated that the *Sprague* is the most economical boat on the river, and that an indicated horse power is furnished on 2 pounds of Pittsburg coal.

The very large boiler capacity gives abundant steam for all purposes, which in this class of towboat are not only for the vessel itself, but for running the siphon pumps used to keep the loaded barges free of water.

COMPLETING THE TRANSPACIFIC CABLE.

The long-projected enterprise of the American Pacific cable was completed on July 4, 1903, when, as previously noted in these columns, President Roosevelt sent a con-

completed on December 25 last. Since that time the cable steamers of the Commercial Pacific Cable Company have been laying the sections from Manila to Guam, from Guam to Midway Islands, and from Midway



LANDING AT HONOLULU THE TOWLINE TO WHICH THE HAWSER AND LAST STRETCH OF TRANSPACIFIC CABLE WERE BENT.



SPlicing THE HAWSER BY WHICH THE CABLE WAS PULLED ASHORE FROM THE CABLE STEAMER.

[Photographs from Backus Studio, San Francisco, Cal.]

gratulatory message from Oyster Bay, Long Island, to Governor William H. Taft in Manila. On that day the connecting link at Honolulu was made between two sections of the cable.

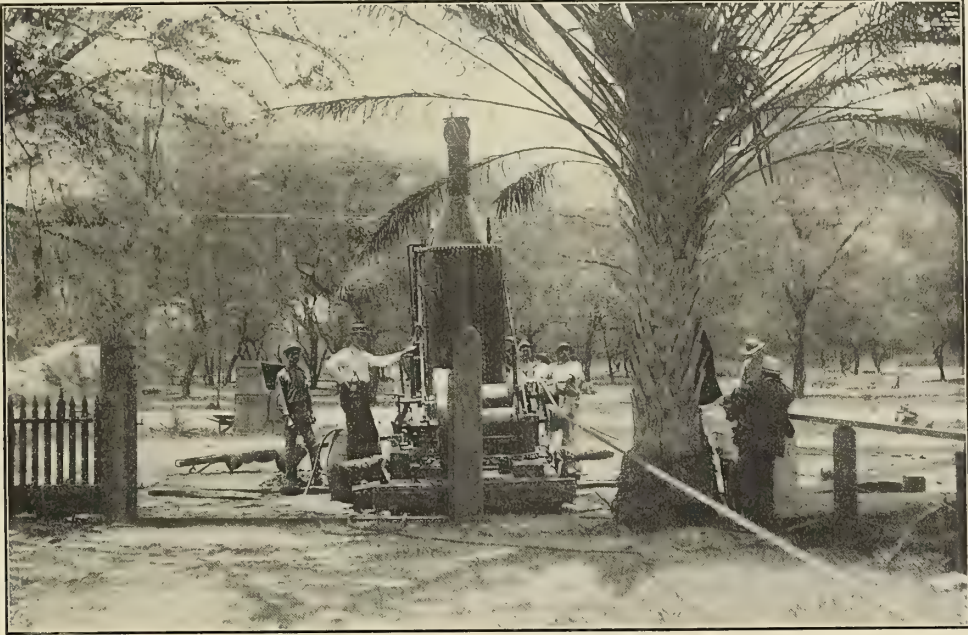
The section from San Francisco to Honolulu was

Islands to Honolulu. It was this last stretch of cable, which was connected at Honolulu on July 4, that completed the through line.

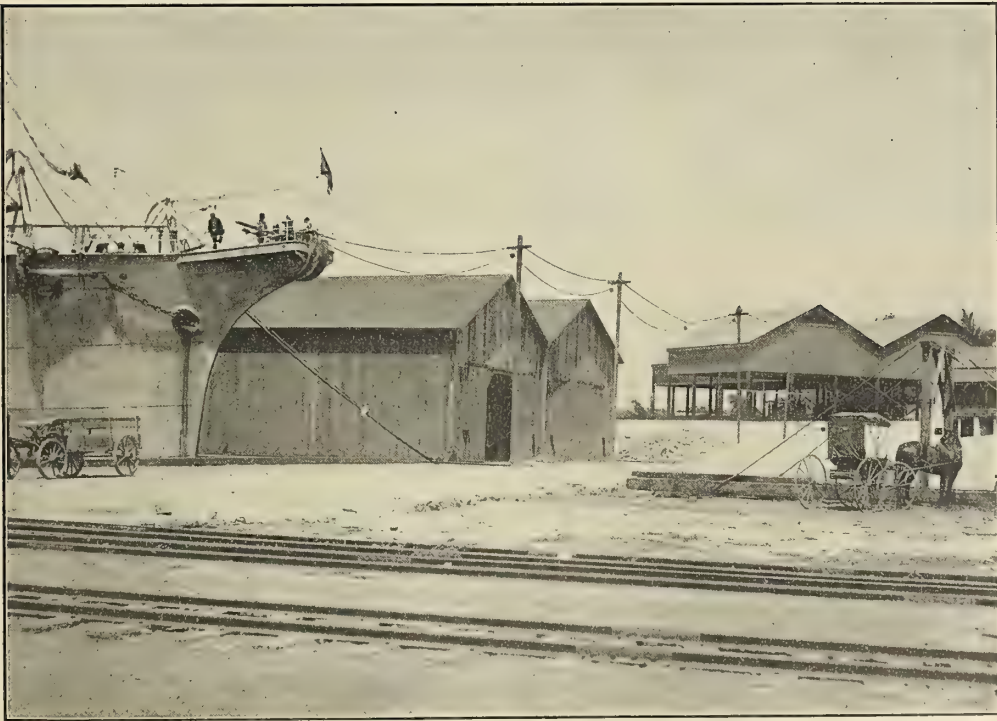
A few minutes after the President's message was sent another message was started, this one to go around the

globe. It was from the President and was addressed to Mr. Clarence Mackay, president of the cable company, at Oyster Bay. The message started westward from Oyster Bay to San Francisco; thence over the new

and to New York. The total length of this route was 25,800 miles. The message came ticking back on the receiver at Oyster Bay just 9 1-2 minutes after it had been started.



HAULING THE CABLE ASHORE AT HONOLULU.



CABLE SHIP LANDING UPTOWN SECTION OF CABLE AT HONOLULU.

[Photographs from Backus Studio, San Francisco, Cal.]

cable to Manila, then to Honolulu, Saigon, Singapore, and Penang; thence to Madras and Bombay in India, still continuing westward to Aden, Suez, Malta, Gibraltar, and Lisbon. From this last point it was sent by the transatlantic cable touching at the Azóres, Canso,

The Navy Department several years ago, under the direction of Lieutenant-Commander John Hood, prepared charts of the Pacific ocean from soundings taken of the bottom of the ocean along the proposed line for the cable. These charts were afterward turned over to

the cable company in exchange for valuable concessions in the use of the cable.

A collection of the parts of the various electrical circuits of historic interest was borrowed from William J. Hammer, and the pieces welded into one and placed in the circuit over which the above messages to go around the world were sent. The collection includes a section of wire over which Professor Morse sent the first message by means of the Morse telegraph; a section of wire over which audible speech was for the first time transmitted by means of the Bell telephone by Professor Bell; a section of the Atlantic cable, through which the first cable message was sent across the ocean by Cyrus W. Field; a section of the wire through which was lighted the first incandescent lamp ever lighted from an electric-lighting central station; and a section

Water-tube Boiler Tests in the British Navy.

The exhaustive tests to which the two British cruisers *Hyacinth* and *Minerva*, the former fitted with Belleville boilers and the latter with Scotch boilers, were subjected under the direction of the Boiler Committee of the Admiralty, have frequently been mentioned in these columns, and it will be recalled that the test showed up most disparagingly for the Belleville boiler. The two ships were of about the same dimensions, but of different form, and were fitted with propellers of different proportions, all of which gave the *Minerva* about one knot greater speed than the *Hyacinth*, although it was found that the engine friction of the two ships was practically the same. New propellers were fitted to the *Hyacinth*, which resulted in giving her about the same speed as the *Minerva*, the latter keeping her original propellers.



WATCHING THE EFFORTS OF THE ENGINEERS TO LAND THE CABLE.

of the cable through which the first current of electricity was transmitted from the Niagara Falls electric power plant.

The method of landing the cable on the beach at Sans Souci, Honolulu, is shown in the accompanying engravings. The cable ship anchored off shore and engineers left the steamer in lifeboats to carry the first light line ashore. To this line was bent a heavy hawser on board the ship. The light line was carried up the beach to the hoisting engine, as shown in the engraving on page 483, and when all was in readiness the engine was started and the line drawn in with the heavy hawser attached. The hawser was then wrapped around the gipsy heads of the engine, and the signal was sent to the ship that all was in readiness to bring ashore the cable.

The men on the ship fastened the land end of the cable to the hawser and the cable started shoreward. Casks were tied to the cable every few feet to keep it afloat, as illustrated above. As soon as it was brought ashore it was taken to a small cable house erected on the beach, the end connected to the instruments, the line tested, and then the world-famous messages were sent.

It was then decided first to send the two vessels from Plymouth to Gibraltar at 7,000 I. H. P. and measure the coal and water consumed, the two vessels carrying out the trial in company and continuing until the main supply of coal was exhausted; second, to ascertain the minimum time necessary after arrival in port to coal, make good any defects, clean boilers, and put to sea again; third, a passage trial from Gibraltar to Portsmouth at the highest speed possible, the test to commence with both vessels lying at anchor at Gibraltar with cold water in the boilers.

On February 4, 1903, the two vessels sailed from Plymouth to Gibraltar, the *Hyacinth* completing the voyage in 135 hours and on 898.5 tons of coal, while the *Minerva* took 160 hours and consumed 989 tons of coal. The amount of make-up feed water required on the *Hyacinth* was 170 tons, and on the *Minerva* 183 tons. All these results show in a most favorable light the Belleville boilers of the *Hyacinth*. The machinery on both vessels worked satisfactorily. A pressure of 2 inches of air was maintained on the *Minerva's* boilers, while on the *Hyacinth* it was about .2 inch.

In the second trial, to determine the time required for coaling and preparing for sea, the *Hyacinth* took 21 hours while the *Minerva* required 45 hours. On the signal being given to light fires and start, the *Hyacinth* got up steam and left the anchorage in 26 minutes, while the *Minerva* took 64 minutes.

The third trial was unfortunately ended by a breakdown of the *Hyacinth's* engines after she had steamed 23 hours. Up to the time of the accident she had averaged a speed of half a knot in excess of the *Minerva*. No defects were noted in the Belleville boilers after these trials.

Another most interesting test of the Belleville boilers was undertaken by the Controller of the Navy. Two cruisers, the *Europa* and *Spartiate*, both fitted with Belleville boilers, were sent from Portsmouth to Hong Kong and back, a distance of 20,000 miles. The idea to be carried out was that, the two ships having been in commission for some time, war suddenly breaks out and before any repairs can be made they are in active service cruising and chasing. Can they in this condition steam 10,000 miles, touching harbor only to coal? The *Europa*, which is accredited with 20 1-4 knots speed and 16,500 horse power, made the run out at 10.75 knots, burning 3,600 tons of coal; and the *Spartiate*, of 20.75 knots and 18,000 horse power, covered the distance at a speed of 13 knots and burned 2,600 tons of coal. On the homeward bound run several full-power 8-hour runs were made, and the *Europa* burned 5,000 tons and the *Spartiate* 4,500, it being stated that the average coal consumption of the two was 1.91 and 1.83 pounds per horse power per hour respectively.

As a result of these two tests the Belleville boiler has evidently regained its prestige with the British Admiralty.

Plans of the 13,000-ton Battleships Approved.

Secretary Moody approved the plans submitted by a majority of the members of the board of construction for the 13,000-ton battleships to be named the *Idaho* and the *Mississippi*. Objections had been raised by Rear-Admiral Bradford, a member of the board, but who was absent from the meeting, against the low speed of 16 1-2 knots and small coal endurance provided for. Rear-Admiral Melville had raised the same objections. The other members of the board are Rear-Admirals Bowles and O'Neil. Our other battleships are of 18-knots speed, and it is claimed that while the new 13,000-ton ships would possess practically the same offensive and defensive powers as our 16,000-ton vessels, yet their smaller speed would be a serious handicap to them. The speed of a fleet is the speed of the slowest vessel.

Rear-Admiral Bowles, who was principally responsible for the designs, has stated as follows:

"In connection with the preparation of the designs careful estimates were made of the radius of action of the principal types of United States battleships built and building, based upon the actual returns of coal expended as compiled from United States steam logs in the Bureau of Steam Engineering. The results of this investigation indicated the number of miles each vessel can steam, starting with full bunkers, at all speeds from 4 to 15 knots. The following table shows the distances at rates of 8, 10, and 13 knots:

	8 knots.	10 knots.	13 knots.
Virginia	3,720	3,820	3,530
Alabama	4,320	4,200	3,500
Maine	4,840	4,900	4,470
Massachusetts	5,050	4,780	4,000
Connecticut	5,270	5,280	4,680
Kearsarge	5,640	5,320	4,070
Idaho	6,000	5,770	4,800

"The design of the modified *Maine* advocated by Rear-Admiral Bradford was intended to duplicate the *Maine's* design in all matters except the disposition of armor and armament, the total weights of the two being the same. This design would, therefore, have the same coal capacity as the present *Maine*, namely, 1,800 tons on the basis of stowage used in these tables. They show that at 8 knots the *Idaho*, with 1,750 tons of coal, steams 1,160 miles farther than the *Maine*, at 10 knots 870 farther, and at 13 knots 330 farther. As a matter of fact the *Idaho* will have greater coal endurance at all cruising speeds than any vessel yet designed. The *Idaho's* great endurance is due to the use of a model adapted to moderate speeds and a consequent low total engine power, both of which reduce the coal burned per mile run."

Lloyd's Register Shipbuilding Returns.

From the returns compiled by Lloyd's Register of Shipping it appears that, excluding warships, there were 426 vessels of 1,028,099 tons gross under construction in the United Kingdom at the close of the quarter ended June 30, 1903.

DESCRIPTION.	JUNE 30, 1903.		JUNE 30, 1902.	
	No.	Gross Tonnage.	No.	Gross Tonnage.
STEAM.				
Steel.....	397	1,020,381	379	1,107,605
Iron	2	360	1	200
Wood and composite.....	2	270	1	160
Total... ..	401	1,021,011	381	1,107,965
SAIL.				
Steel.....	10	5,520	12	20,428
Iron.....	..	..	..	..
Wood and composite ..	15	1,568	13	1,189
Total.....	25	7,088	25	21,617
Total steam and sail..	426	1,028,099	406	1,129,582

The present return shows an increase in the tonnage under construction of about 54,000 tons as compared with the figures for last quarter, but a decrease of about 385,000 tons as compared with the total reached in September, 1901, which is the highest on record.

Of these, 340 vessels of 857,342 gross tonnage are built for companies in the United Kingdom.

The division of the tonnage among the principal districts is as follows:

DISTRICT.	No.	GROSS TONNAGE.
Belfast.....	20	195,648
Barrow, Maryport, and Workington..	13	28,840
Glasgow.....	78	200,907
Greenock.....	39	111,260
Hartlepool and Whitby.....	20	71,771
Middlesbro' and Stockton.....	27	69,914
Newcastle.....	76	180,783
Sunderland.....	37	124,066

Marine Engineering

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE attention of our readers has from time to time been called to the decreasing amount of American tonnage engaged in foreign trade and to the deplorable condition of American shipbuilding. Consideration of this phase of commerce is indeed discouraging and one which the average citizen will postpone to some future day. The facts of the case, however, warrant immediate attention, in order that the remnant of our ocean-carrying trade and our shipyards may be saved.

In 1810, when the population of the United States was about seven millions, 91.5 per cent. of our foreign trade was carried in American ships of a gross tonnage of 981,000 tons. Forty-nine years later, at the outbreak of the Civil War, the proportion of our foreign commerce carried in American bottoms had decreased to 65.2 per cent., but the tonnage had increased to 2,496,000 tons. Now let us consider the discouraging statement of shipping for the past year. The tonnage in our foreign carrying trade has dwindled to 873,000 tons, we carried but 8.8 per cent. of our foreign commerce, and, moreover, not a single keel for a deep-sea ship has been laid in

this country for two years. It is difficult to realize the truth of these facts at a time when other industries are prospering and we are looked upon as the leading producing and manufacturing country of the world. Transportation by sea has, of course, necessarily kept pace with industrial expansion, and the British have been quick to realize the opportunity; their foreign tonnage has now assumed the enormous figure of 14,800,000 tons. Germany comes next with 2,960,000 tons. France and Norway have each about one-half of Germany's tonnage, and Italy's amounts to 1,180,000. The United States is paying annually foreign steamship corporations one hundred millions of dollars for carrying our freight and passengers.

The question immediately raised is, how has this condition of affairs come about? If we once were such great ship builders and owners, why have we relinquished to foreigners our hold on these remunerative industries? While we cannot attempt to answer this complex question, we wish to call attention to a few of the conditions which more or less have had to do with the present state of affairs.

The United States was backward in developing her iron industry, while in England the rich deposits of coal and iron were being mined. As a result Great Britain speedily became the leader of the world in iron products and built up a great fleet of iron ships. This position she has held, increasing in strength year by year; and although we have now taken the lead in volume of iron produced, she far outstrips us in tonnage of vessels afloat. Another reason for our failure to progress in shipbuilding is that the price of ships and the cost of operating them are so much in excess for ships flying the American flag over those of foreign register that capitalists have naturally preferred to invest their money in more remunerative directions. The available work for our coast shipyards has been so small that they have of necessity had to engage in general shipbuilding, and, as a result, cargo ships, yachts, or torpedo boats may be seen building on adjoining stocks, and more or less the same methods of construction used in each. For a yard to build cheaply it is necessary to build one type of boat exclusively. Our ability to turn out cheap boats under such conditions is demonstrated by the Great Lakes shipping, where vessels of 10,000-ton capacity are completed within ninety days of laying the keel and at a very low cost. Again, all foreign countries subsidize their ships to a greater

or less extent for carrying the mails and for other special privileges granted, and it is against these government-protected vessels that our ships, more expensive to both build and operate, must compete. The handicap to our vessels is most apparent.

Having touched upon the above facts, we call upon our readers for their views as to remedies to be applied, whether by legislation in the form of subsidies, discriminating duties, or free ships, or whether the case lies outside the sphere of legislative action. All must agree, however, that something must be done, and that quickly, in order to save our ships and shipyards. It is a momentous question, one which affects all classes of our great people, whether interested directly or not in maritime affairs.

THE public press has recently contained references to the use of air propellers for marine propulsion. In one case the device seems to have been fitted on a small boat intended for shallow-water navigation on some of the inland waters of France. In the other it was fitted as a means of propulsion for an iceboat which was experimented with on a small lake on Long Island. The latter application is not one which is likely to bring it into serious competition with the usual type of water propeller, and may be here dismissed with the passing notice. In the case of the boat, a water propeller was first fitted, the diameter being about 24 inches and draft of boat but 6 inches. With this equipment a speed of 12 miles per hour is said to have been realized. With this arrangement, in spite of the small draft of the boat, navigation was of course limited to water of sufficient depth to provide for the wheel with its excessive drop below the keel. To remove this limitation the water propeller was removed and an air propeller mounted on deck, carried on a shaft driven by belting from the engine shaft. The air propeller was some 45 inches in diameter, or not quite twice the diameter of the water propeller. With this arrangement a speed of 10 miles per hour is said to have been attained, and the boat was free to navigate anywhere within the limit of its six inches of draft. Looked at from this point of view the exchange seems to have been thoroughly successful in attaining the purpose desired.

Outside the existence of extraordinary circumstances which may, as in the case cited, justify such a type of propelling mechanism, the chief

question of interest has reference to the propulsive efficiency of the air propeller as compared with that of the usual type. It may be shown that, due to the low density of air as compared with water, an air propeller, in order to operate under the same general conditions of efficiency as a water propeller, must be some 20 or 25 times greater in size. In the case above cited this would have called for a propeller some 40 feet in diameter, a size quite out of the question, of course, on a small boat some 25 or 30 feet in length. If the size of the air propeller is less than as indicated by this relation, it may be expected that the efficiency will decrease in corresponding proportion. It follows, as a matter of practical construction, that no air propeller can hope to operate under the same general efficiency conditions as a water propeller, simply on account of the excessive size which would be required. In the case cited, where an air propeller of about twice the diameter of the water propeller was employed, we should therefore expect a marked falling off in the propulsive efficiency, and this seems to be shown by the results obtained. At first sight it may seem that a decrease in speed from 12 miles to 10 miles is not very serious, or, from a different point of view, that a speed of 10 miles per hour is very satisfactory for a boat of the size and class in question. Such may indeed be the case; but, viewed purely from the standpoint of propulsive efficiency, we must remember that the power required in such case will vary at least as the cube of the speed, and hence in this case there must have been a loss of efficiency of not less than 40 per cent. That is, the propeller efficiency was presumably somewhere about .40 instead of .68. While in the given case this loss may not have been serious, it is evident that in general such losses could not be accepted, and that any system of propulsion in which losses of this general character are likely to arise can hardly be considered as a serious rival to the accepted system.

Quite independent of the propulsive efficiency of the air propeller, the system presents serious structural problems, and there remains the question of navigation in a head wind. No system of propulsion can be considered satisfactory, of course, which depends on the direction of the wind for its practicability or efficiency, and, except for the purpose of illustrating an important point in propulsive efficiency, the air propeller would hardly merit our serious attention in these columns.

QUERIES AND ANSWERS.

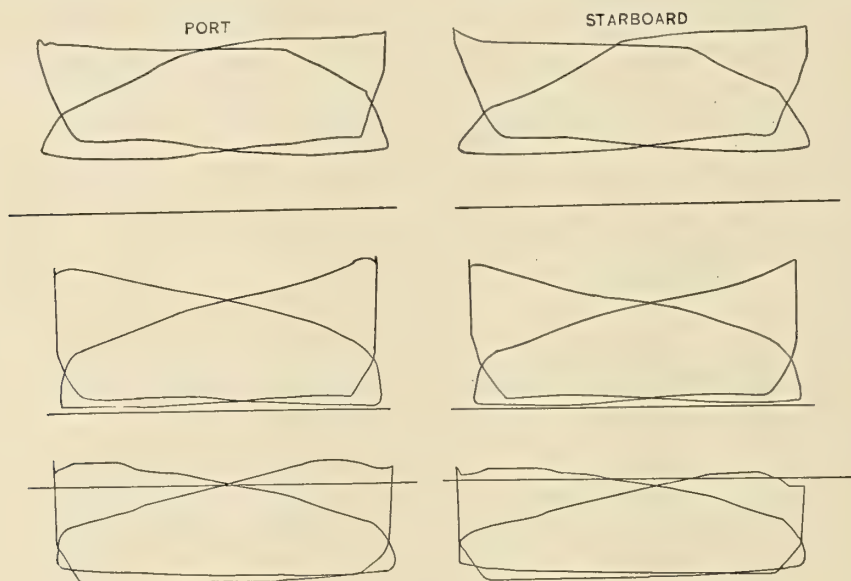
Q. 157.—A triple-expansion engine, when working to full capacity, has the load fairly distributed between the three engines. When under reduced speed the high-pressure engine is linked up and the intermediate and low-pressure engines are left wide open, with the result that the load is no longer equally distributed over the three engines. Say the intermediate and low-pressure engines are linked up until each engine is developing the same power.

(a) Will this have any advantage, other than the wear on the bearings being about the same?

(b) Will the engine be run more economically by linking in the intermediate and low-pressure engines? If so, which would produce the best results, to link the intermediate and low-pressure engines just the same amount the high-pressure engine is linked in, or link them in until the three engines are just balanced?

(c) In twin-screw ships one engine usually drives easier than the other. Which is the best method to run both engines—the same speed, or place the position of the links on the high-pressure engines just the same and allow each engine to make what it will for that particular position of links?

J. M.



Marine Engineering

FIRST SET OF INDICATOR CARDS WITH SAME CUT-OFF.

A.—In the first place, it may be noted that change of cut-off in the high-pressure cylinder does not affect the distribution of the load as much as change in either of the other two cylinders, and not as much as you seem to believe from the way in which the question is put. Change of cut-off in the high-pressure cylinder affects the amount of steam entering the engine, and thus raises or lowers the schedule of pressure all the way through the intermediate and low-pressure cylinders. This will affect the total power developed and to some extent the distribution of load, but not as much relatively as a change in the other cylinders. However, with independent adjustments on each engine, as are now commonly fitted, the intermediate and low-pressure cut-offs may always be so adjusted as to practically equalize the load in the three cylinders, as you assume. The chief advantages of such adjustment are found, as you suggest, in the mechanical operation of the engine. The bearings wear more evenly, the engine usually turns more uniformly, and in addition the conditions for good steam economy are rather better fulfilled with an evenly

distributed load. The guide for such an adjustment should be to divide the power, as nearly as may be, equally between the cylinders, or, if there is any variation, it is usually found better to have the least power developed in the high-pressure, next in the intermediate, and the most in the low-pressure. The intermediate-pressure and low-pressure links should therefore be adjusted with reference to the balance of power, rather than with reference to each other or to the high-pressure link.

With twin-screw engines it is usually well to run both engines at as nearly the same speed as can be readily done without any attempt at too refined adjustments. In all practical cases one will run slightly faster than the other with what seems to be the same setting of the links, and if the difference is not great they may be allowed to run in this manner. If the difference seems too great, however, one link may be adjusted until the

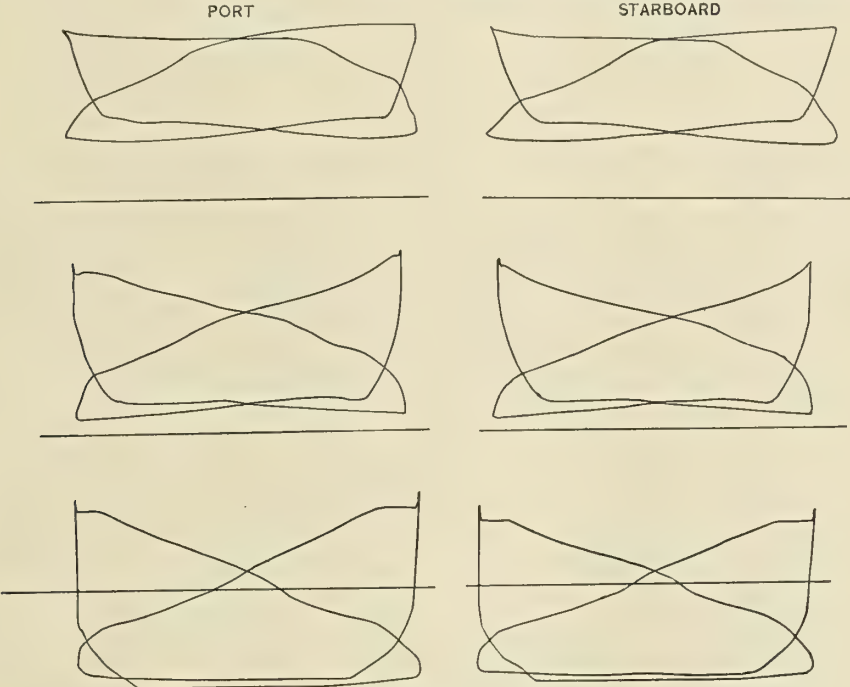
revolutions are nearly the same on both sides, and the engines may then be allowed to run in that adjustment. There is usually more or less change and irregularity in the revolutions, so that even if the two engines could for a minute or two be brought into perfect step they would not long remain in such condition, but would fluctuate back and forth through a range of variation the extent of which will depend on the circumstances of the case.

DATA FOR FIRST SET.

	Port.	Starboard.
Revolutions.....	80.5	80.5
Boiler pressure.....	197 lbs.	197 lbs.
First receiver.....	67.5 "	60 "
Second ".....	7.0 "	6.5 "
Vacuum.....	25 ins.	25 ins.
Cut-off H. P.....	29 1-8 "	27 1-4 "
I. P.....	29 1-8 "	29 1-8 "
L. P.....	29 1-8 "	29 3-8 "
Throttle.....	Full open.	Full open.
M. E. P.—H. P.....	90 lbs.	90 lbs.
I. P.....	39 "	38.5 "
L. P.....	8.88 "	8 25 "
I. H. P.—H. P.....	435.6	435.6
I. P.....	502.6	496.2
L. P.....	347.1	322.6
Total.....	1,285.3	1,254.4

Size of engines..... 19, 31, and 54 ins. by 42 ins. stroke.
Diameter of rods..... 5 ins.
Scale of springs..... H. P.=100; I. P.=40; L. P.=10 lbs.

DATA FOR SECOND SET.			
	Port.	Starboard.	
Revolutions.....	80.16	80.16	
Boiler pressure.....	197 lbs.	197 lbs.	
First receiver.....	77.5 "	68 "	
Second ".....	14.5 "	12 5 "	
Vacuum.....	25 ins.	25 ins.	
Cut-off H. P.....	29 1-8 "	27 1-4 "	
I. P.....	27 1-4 "	27 1-4 "	
L. P.....	22 1-8 "	22 1-8 "	
Throttle....	Full open.	Full open.	
M. E. P.—H. P.....	78. lbs.	78.5 lbs.	
I. P.....	35.8 "	33.5 "	
L. P.....	11.5 "	10.8 "	
I. H. P.—H. P.....	376.0	378.4	
I. P.....	458.8	427 9	
L. P.....	447.8	418.6	
Total.....	1282.6	1224.9	



SECOND SET OF INDICATOR CARDS WITH DIFFERENT CUT-OFF FOR DIFFERENT CYLINDERS.

The accompanying cards and data show clearly the effect of linking up in the intermediate and low-pressure cylinders. In general, linking up in the low-pressure will give more work in this cylinder and less in the intermediate-pressure, while linking up in the intermediate-pressure will give more work in this cylinder and less in the high-pressure, and *vice versa* in each case. The adjustment in the second trial might have been made still better by linking up a little more in the low-pressure cylinder and opening out a trifle in the intermediate-pressure. This would have tended to give a still more even distribution of work.

Q. 159.—Will you please tell me how many 16- or 32-candle-power lamps can be placed on a 9-kilowatt dynamo? Also give me rule for determining this.

A.—On a 9-kilowatt dynamo 117 of 16-candle-power lamps of so-called low economy type may be installed, or 58 of 32-candle-power similar lamps. About 3.4 to 3.8 watts per candle power is the amount of current which should be allowed for this class of lamps, which is the one generally installed, because it is the cheapest. Solv-

ing your example with the former figure of 3.4 watts it is as follows:

$3.4 \times 16 = 76.4$ watts per lamp.
 $9 \text{ kilowatts} = 9,000 \text{ watts. } 9,000 \div 76.4 = 117.8.$

Q. 162.—Will you please advise how to calculate the heating surface of a corrugated furnace flue of the Morison and Fox types?

A.—The heating value of a corrugated furnace has been found to be no greater than that of a plain cylindrical furnace, and in estimating the heating surface of a corrugated furnace the makers consider it the same as for a plain cylinder of diameter equal to mean diameter of the corrugated furnace.

Q. 163.—Will you please advise at what speed a 4 by 3 1-2 single-cylinder engine will drive a propeller wheel 20 inches diameter, the pitch to be best suited for a 26-foot launch; the

boiler pressure is 100 pounds and the engine runs non-condensing?
T. C. M.

A.—A question such as this, which leaves so much to be assumed, can only be answered in an approximate way. Assuming about 400 revolutions, we find that such an engine should develop somewhere about 6 I. H. P., and should drive a 26-foot launch of ordinary type about 7 miles per hour. Taking a propeller 20 inches diameter and working out a suitable pitch, it is found to be about 25 inches. That is, by solving the problem backward we find that a propeller 20 inches diameter and 25 inches pitch, run at about 400 revolutions per minute, should absorb the 6 I. H. P. with reasonable efficiency and give a speed of somewhere about 7 miles per hour. Such a propeller should have four blades and each blade should have about 32 square inches surface.

Floating Dock.—A large floating dry-dock was successfully launched at Perth Amboy, N. J., on August 1. This dock is owned by the Raritan Dry-Dock Company, the builder, and is 302 feet over all, 92 feet wide, 42 feet deep, with 22 feet of water over keel blocks.

ENGINEERING SPECIALTIES.

Special Marine Motor.

The Northern Electrical Manufacturing Company, Madison, Wis., has evolved a special type of motor which, among other specific purposes, is particularly well suited for the operation of electric launches. It is readily adapted to the frame and equipment of a modern launch, and, having a very low center of gravity, can be placed on the keel; adding to the safety and stability of the boat, as well as projecting but little into the cockpit.

The field frame of this motor is cast with a circumferential ring, which is machined in accurate alignment with the armature shaft. The bearings are mounted in

be bolted to the boat frames. The illustration accompanying shows electric launches equipped with Northern motors. The steering and controlling mechanisms in this boat are located in the bow, and the motor controller occupies practically no room required for passengers. The controller may be placed at whatever point in the launch is most convenient.

Vertical Marine Type Engine.

To meet the requirements of continued hard service, the American Blower Company, Detroit, Mich., has especially designed an open-frame extra heavy engine, which is illustrated in the cut on opposite page.



ELECTRIC LAUNCHES EQUIPPED WITH NORTHERN ELECTRIC MOTORS.

patented bonnets, and lubricate the shaft by the oil-ring method, ample storage capacity being provided for oil.

The construction of the bearings is such that the motor may be applied at any angle, varying from horizontal to the position necessitated by the inclination of the propeller shaft. When built as a marine motor the Northern universal type motor armature shaft terminates in a disk which forms one half of the coupling with the propeller shaft. A similar disk is mounted on the propeller shaft, and the two bolted together.

These motors are built in sizes ranging from 2 to 40 horse power, to operate at speeds specified by the purchaser. The electrical construction of the motor is such as to secure great economy in the consumption of current and not entail severe drains on the storage batteries by losses in the motor.

The motor may be secured to the boat frames by means of legs bolted to the motor field and the current frames, or by means of a circular split bracket with provision for securing the motor in place, the bracket to

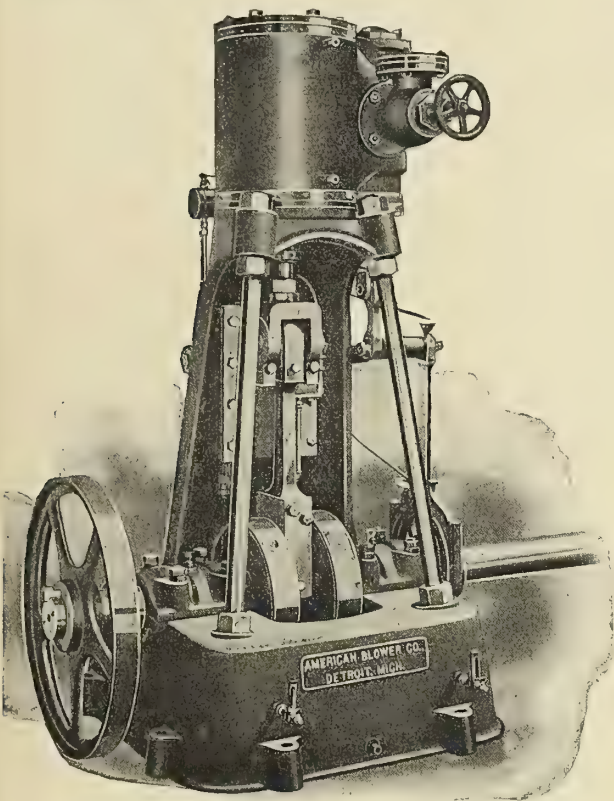
The base is a solid casting, dished to receive the drippings of oil and water from the engine. The main bearings are made large, and lined with the best quality of anti-friction metal, and provided with ring oilers. The lower halves of these bearings are cast solid in the base, with chambers to hold the oil. The back frame is of cast iron, to which are attached the crosshead guides, and the top forms the base of the cylinder casting. The front columns are of steel, the tops setting in lugs on the back frame.

The cylinder and steam chest are in one casting securely bolted to the frame. A double-ported balance piston valve properly designed is fitted, and the steam ports are ample and allow a thorough drainage. Eccentric and strap are of cast-iron, and the rod is of cast-steel provided with adjustment for taking up wear. The piston is a hollow disk fitted with snap packing rings. The crank shaft and connecting rod are of cast-steel, the latter having forked crank ends, and both ends are provided with means for taking up wear. This adjustment

is accomplished by taper keys moved by screws and secured in position by lock nuts. The crosshead is a solid casting and is of the slipper type. As above mentioned, the guide is cast to the engine frame, but the front guides are of forged-steel, securely bolted to the frame of the engine.

The engine is fitted with a sight-feed lubricator, and all the moving parts, with the exception of the main bearings, piston, and valve, are lubricated by a single oiling device. The engine is also fitted with throttle valve, cocks, Rites' governor, and hand wheel.

Two of these engines were included in the steamer *Sprague* outfit.

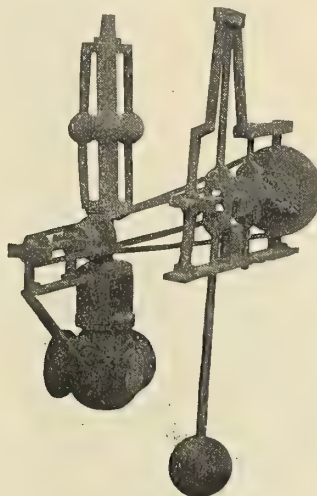


VERTICAL ENGINE FOR HEAVY SERVICE.

Marine Engine Governor.

The engraving shows the essential features of a new marine engine governor patented and made by M. F. Volkmann, Santa Monica, Cal., which it is claimed will act under all conditions. It consists of a centrifugal governor, whose driving shaft is constructed for two speeds, receiving power from a main driving shaft by sprocket wheel and chain connection. The main driving shaft is driven from the crank shaft by gearing and shafting, and carries a loosely-mounted sprocket wheel, larger than the others, having the hub extended on each side, and connected by chain to the governor shaft. Two power-controlled friction clutches are mounted on the shaft to engage the hub of the loosely mounted wheel; the action of one is controlled by a pendulum and valve, the other by a float-controlled valve, to which it is connected by piping, the float being placed in a well near the propeller.

In order that a governor work successfully on a marine engine it is necessary that it should anticipate an increase in engine speed due to the propeller coming out of the water. In the Volkmann governor this is accomplished by means of the pendulum-controlled valve that allows a clutch to change the governor speed when the stern of the ship is about to rise. A simple device, not shown in the engraving, that controls a piston and rod, is employed to move the pendulum rearward when the stern of the ship begins to descend, thus releasing the pendulum-controlled clutch and preventing unnecessary loss of speed. The float-controlled valve at the stern allows the governor speed to be changed at any time when the propeller is not sufficiently immersed, and will prevent the engines racing if the propeller is not sufficiently immersed when the pendulum-controlled clutch is released. As the governor is driven by the engine, it is impossible for them to race beyond a safe speed should an accident occur to the propeller or to the shaft.



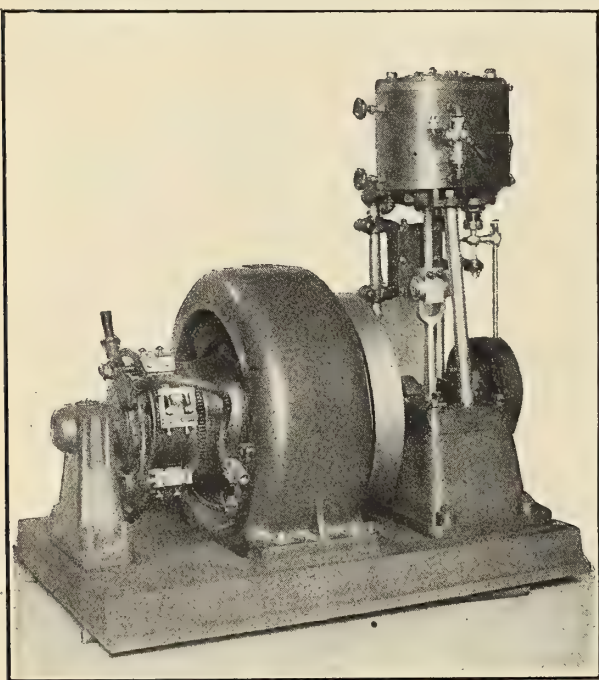
A MARINE ENGINE GOVERNOR.

A New Direct-Connected Set.

A small direct-connected engine-generator set for marine purposes, possessing many qualities that will appeal to those concerned with the design and equipment of small steam vessels, is illustrated on the following page. It presents the association of a Crocker-Wheeler multipolar open-type generator and a Forbes simple upright engine, each a standard piece of apparatus, with only such changes made in details as were necessary to bring them into perfect harmony of operation.

Of primary importance among its commendable features are the lightness and compactness of the outfit. Although it has a capacity of 8 kilowatts, or sufficient to light upward of 140 16-candle-power lamps, it weighs but 2,800 pounds, and in extreme dimensions measures only 52 5/8 inches long, 35 1/4 inches wide, and 51 3/4 inches high. The engine has a 7-inch cylinder, a 6-inch stroke, and with a steam pressure of 100 pounds develops 20 indicated horse power at 425 revolutions per

minute. By itself the engine weighs but 475 pounds, principally possible due to its very light and simple tripod-frame construction, the legs of which are of steel, so that it possesses all of the desirable characteristics of rigidity and safety. A cylindrical type of valve is employed, and the speed regulation is afforded by a Rites form of inertia governor guaranteed not to allow a variation of more than 2 1-2 per cent. from constant speed. The governor is entirely distinct from the flywheel, the latter being placed between the engine and the generator, covering the coupling, while the former is self-contained and located on the opposite end of the shaft. The crosshead and piston rod are in one piece; all forgings are of the best open-hearth steel without welds, and the crank shaft is machined from a solid forging. The oiling can be accomplished while the engine is in motion; equipment, though not so shown



HIGH-SPEED, DIRECT-CONNECTED GENERATING SET.

in the cut, consisting of a gravity lubricating system composed of a number of small pipes leading from an elevated reservoir to all the wearing parts.

In service of this class the need of an enclosed type of dynamo is not felt. Almost invariably a location may be selected where dust and inflammable materials are not present, and where the slight protection required is readily procurable. Being of open construction, this generator has special advantages, such as accessibility of its parts for instant inspection or attention of any sort, and the best possible ventilation for the armature and windings, thereby keeping the heating down to desirably low limits even under a high per cent. of overload.

The engine builder is W. D. Forbes Company, Hoboken, N. J., and the Crocker-Wheeler Company, electrical engineers and manufacturers, of Ampere, N. J., supplies the dynamo.

LAUNCHES.

Fireboat Hewitt.—The fireboat *Abram S. Hewitt*, built for the City of New York, was launched on July 11 from the yard of the New York Shipbuilding Company, Camden, N. J. The *Hewitt* is one of the swiftest and most powerful fireboats built. Her principal dimensions are: length, 110 feet; beam, 24 feet, with a speed of 10 knots an hour. This boat was described in MARINE ENGINEERING for March, 1903.

Steamer Saxon.—On Saturday, June 6, there was launched from the old Globe yard, Cleveland, the steamer *Saxon*, the last of three 6,200-ton steamers being built by the American Shipbuilding Company for G. A. Tomlinson, of Duluth. The principal dimensions of the *Saxon* are: length over all, 436 feet; length over keel, 416 feet; beam, 50 feet; depth, 28 feet. She will have triple-expansion engines with cylinders 20, 33 1-3, and 55 inches diameter and 40 inches stroke, supplied with steam from two Scotch boilers 13 feet 2 inches in diameter and 11 1-2 feet long, fitted with Ellis and Eaves draft.

Steamer C. W. Morse.—On July 11 the steamer *C. W. Morse* was successfully launched at Wilmington, Del., for the People's Evening Line for service between New York and Albany. This vessel is built of steel and is 430 feet over all. She has three full state-room decks above the main deck. The interior decorations of the saloons, galleries, and state rooms will be in the Louis XVI. style, in white and gold. The dining room on the main deck will seat 300 persons. The boat has been towed to New York to the yards of the A. and F. Fletcher Company, Jersey City, where her engines and joinery will be fitted.

Turkish Cruiser Medjidie.—The *Medjidie*, the first Turkish cruiser built in the United States, was successfully launched at Cramps' shipyard on July 25. The principal dimensions of this vessel are: length on water line, 330 feet; beam, extreme, 42 feet; draft, mean, 16 feet. Her displacement will be about 3,250 tons and she is designed to indicate 12,000 horse power. She will be fitted with two masts with military tops. Her battery will comprise two 6-inch guns mounted fore and aft on the center line, eight 4.7-inch guns mounted broadside, and six 3-pounders and six 1-pounder rapid-fire guns. The *Medjidie* has been constructed for a speed of 22 knots an hour and will be fitted with modern triple-expansion engines and improved water-tube boilers.

Battleship King Edward VII.—On July 25 the new British battleship *King Edward VII.* was successfully launched at Devonport. The *King Edward VII.* is stated to be the largest battleship in the world, being 350 tons more than the *Louisiana*, building at Newport News, and the *Connecticut*, now building in New York. Her principal dimensions are: length, 425 feet; beam, 78 feet; draft, 26 3-4 feet. The engines are designed to indicate about 18,000 horse power. The armament of the *King Edward VII.* consists of four 12-inch guns, four 9.2-inch guns, ten 6-inch guns, and twenty-four guns of smaller caliber. Her estimated speed is 18.5 knots and she carries 950 tons of coal and has a complement of 800 men.

Steamer Captain W. Menzell.—The steamer *Captain W. Menzell* was launched from the yard of the Flensburg Shipbuilding Company, Flensburg, Germany, on July 14. The vessel is 301 feet long, 41 feet broad, and 21 feet 3 inches deep. She will have a carrying capacity of 3,550 tons, and is built to the requirements of the German Lloyd's for the Hanseatic Dampfer Compagnie, Hamburg, which firm will use her for its trade with China.

German Steamship.—On March 5 the Flensburger Schiffbau Gesellschaft, Flensburg, Germany, launched from its yard the steel screw passenger and cargo steamer *Prinz Joachim*. The principal dimensions are as follows: length over all, 385 feet; between perpendiculars, 370 feet; breadth, extreme, 45 feet 3 inches. The *Prinz Joachim* is built for the Hamburg-American Line and is a sister ship to one built for the same firm in November last. She is constructed of best Siemens-Martin steel, according to the requirements of the German Lloyd's and Seeverufsgenossenschaft, having long poop, short forecastle, and steel decks running the whole length of the ship, also eight extra water-tight bulkheads. The vessel is propelled by engines of the direct-acting, quadruple-expansion type, of 3,000 I.H.P., with cylinders 23 1-4, 33 1-4, and 49 1-4 inches and 54 inches stroke, giving her a speed of 13 1-2 knots. Steam is supplied from three single-end boilers, 14 feet 11 inches by 12 feet 1 inch long, provided with forced draft. The christening ceremony was performed by Fräulein Henny Bauer, daughter of Director Bauer, of the Flensburg Company.

PERSONALS.

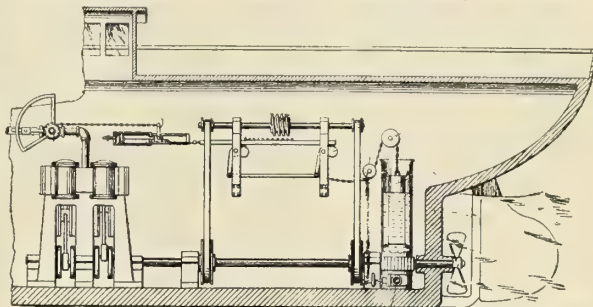
Edwin E. Mager has left the construction and repair department of the Brooklyn Navy Yard to accept a position in the hull department of the New York Shipbuilding Company.

Harry Fromm, marine engine draftsman, has severed connections with the Crescent Shipyard Company and is now in the drafting department of the Townsend-Downey Shipbuilding Company.

Captain George M. Walker, late of the Old Dominion Line, died at his residence in Brooklyn on July 31, aged 77. On his retirement from active life he was the oldest captain sailing out of the port of New York. He was born at sea in July, 1826, his father being captain of the British brig *Fox*. In his early career he sailed in the *Humboldt*, then on the *Washington*, the *Franklin*, and the *Arego*. He then became captain of the *Fulton*, and carried stores to Port Royal during the Civil War. He captured the blockade runner *Margaret and Jessie*, and later another blockade runner, the *Banshee*, off Wilmington, Del. Later Captain Walker commanded the *Raleigh*, *Niagara*, *Albemarle*, and innumerable other well-known steamers. While on the *Albemarle* he received a gold medal for rescuing the crew of a wrecked schooner. He led an exceedingly active life, and retained to the very last years of his seafaring life his mental and physical faculties. He was held in high esteem by all the officers of the Old Dominion Steamship Company, with whom he was connected for so many years, and was respected by all who came in contact with him.

SELECTED MARINE PATENTS.

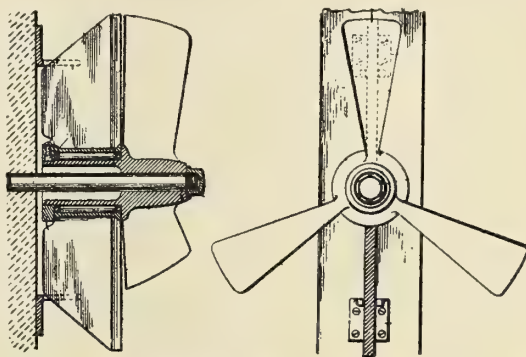
732,567. MARINE-ENGINE GOVERNOR. GEORGE F. LASHER, PORTLAND, OREGON, ASSIGNOR OF ONE-HALF TO ISAAC B. HÖLZMAN, PORTLAND, OREGON.



Claim.—1. A marine-engine governor, comprising a stand pipe in the vessel, a float working in the stand pipe, a driven gear, a gear normally disengaged from the first-named gear and capable of meshing therewith, means for moving the second gear into mesh with the first-named gear and actuated from the said float, and a connection between the second-named gear and the engine.

2. A marine-engine governor, comprising a stand pipe in the vessel, a float working in the stand pipe, a driven member, a second member normally disengaged from the said driven member and movable into engagement therewith, cams actuated from the float for moving the second member into engagement with the driven member, and a connection between the second-named member and the engine. Ten claims.

732,568. SELF-CLEARING PROPELLER. CHARLES H. LEE, SOUTHAMPTON, N. Y.



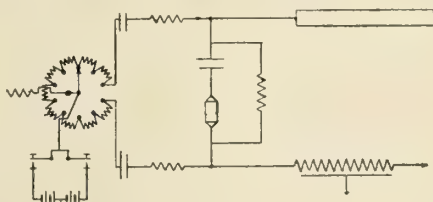
Claim.—2. The combination with a screw propeller, of a non-revoluble clearing device carried directly by a part revoluble with said propeller, located forward of the latter, and occupying a predetermined invariable relation to the blades thereof. Fifteen claims.

732,920. SUBMARINE BOAT. FRANK T. CABLE, NEW SUFFOLK, N. Y., ASSIGNOR TO ELECTRIC BOAT COMPANY, A CORPORATION OF NEW JERSEY.



Claim.—1. The combination with a boat, of a tube in the same containing a slidable piston weight, a fluid in said tube and filling the same, and means for shifting said fluid from one side of said weight to the other proportionately for shifting the position of the weight along the tube. Three claims.

733,556. SUBMARINE TELEGRAPHY. ALEXANDER MUIRHEAD, SHORTLANDS, ENGLAND.



Claim.—1. In a duplex submarine telegraph circuit, the combination of a transmitter and its battery, sending and receiving condensers, a rheostat, a receiver, self-inductances serving to regulate the amount of "curb" required to produce the most rapid changes at the beginning of the cable, further self-in-

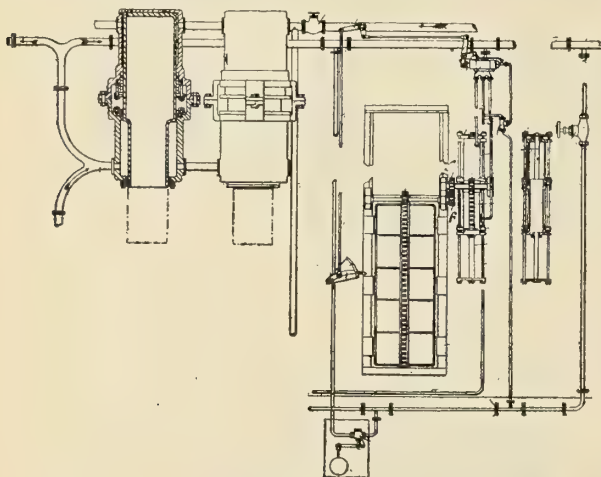
ductance serving as a shunt to the said receiver and its condenser through which the steady current passes while current impulses or rapid variations of potential operate such receiver, and other self-inductances serving to facilitate the final duplex balancing. Four claims.

733,583. FREIGHT BARGE. LEWIS P. HARVEY, OAKLAND, CAL., ASSIGNOR OF THREE-FOURTHS TO WILLIAM LEACH AND EDWARD S. HOUGH, OAKLAND, CAL., AND JAMES DICKIE, SAN FRANCISCO, CAL.

Claim.—1. A barge having a cylindrical body portion with conical ends, air chambers formed in the conical ends, and means connecting the conical ends inside the body portion.

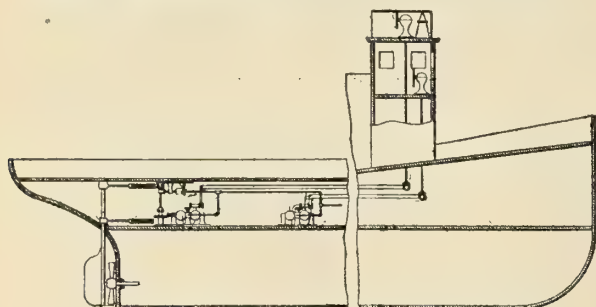
3. A barge having a cylindrical body portion with conical ends, bulkheads separating the body portion from the conical ends and forming air chambers, and a longitudinal partition connecting said bulkheads, said partition extending from the keelson to the top in the center but tapering at its ends to admit a flow of the cargo. Five claims.

733,745. MECHANISM FOR OPERATING BULKHEAD OR OTHER DOORS. GAVIN C. RALSTON, LONDON, ENGLAND, ASSIGNOR TO J. STONE AND COMPANY, DEPTFORD, ENGLAND.



Claim.—1. In a bulkhead door operating installation consisting of a pump, a hydraulic accumulator, cylinders supplied with water pressure therefrom, connections between the cylinder pistons and the doors for operating the latter, valve devices (the emergency valve) for distributing said pressure to the cylinder pistons, and a valve operated from the bridge, in the engine room, or other part of the ship for effecting the simultaneous closing and opening of all the doors, a pipe connection between the accumulator and the steam boiler, a handle at each door and connections between the same and the said emergency valve whereby, after the doors have been closed by the aforesaid valve from the bridge, any men enclosed behind the closed bulkhead doors can, by operating the aforesaid handle, again open communication between the partly-exhausted accumulator and the door cylinder so as to open said door, the steam from the boiler following up the receding ram and water in the accumulator, and whereby when the men have escaped and let go the handle the door closes of itself again.

733,893. STEERING GEAR FOR BOATS. EARL C. AKERS, PORT HURON, MICH., ASSIGNOR TO WILLIS A. PAGE, CHICAGO, ILL.



Claim.—1. The combination with a main steering gear of a boat, embracing a rudder post, of an auxiliary steering gear comprising, in combination with a quadrant fixed to said post, a spare steering wheel, a rotative shaft, means whereby said shaft is rotated through power applied to the spare steering wheel, and clutch elements on said auxiliary quadrant and shaft which are normally out of engagement, and means for moving such clutch elements into engagement.

2. The combination with the main steering gear of a boat, embracing a rudder post, of an auxiliary steering gear comprising

an auxiliary quadrant fixed to said rudder post, a spare steering wheel, a rotative shaft, means whereby said shaft is rotated by power applied to the spare steering wheel, a clutch collar on said shaft which is normally out of engagement with said auxiliary quadrant, and means for moving said collar into engagement with a friction surface on the auxiliary quadrant. Six claims.

733,910. ART OF DETERMINING THE NAUTICAL BEARING OF NAVIGABLE VESSELS. HERMON W. LADD, BOSTON, MASS., ASSIGNOR TO GEORGE E. SMITH, TRUSTEE, EVERETT, MASS.

Claim.—1. The method of determining the direction of motion of Herzian signal waves, which consists in shielding an elevated conductor of a wireless telegraph receiving station from said waves on certain sides and exposing it to waves on one side, and in rotating the shielding element until the receiving conductor is exposed to said waves.

2. The method of receiving Herzian signal waves from any one of a number of signaling stations, to the exclusion of similar waves from other stations, which consists in shielding the elevated conductor of a wireless telegraph receiving station from such waves in certain directions, and exposing it in the direction from which the desired signal waves emanate.

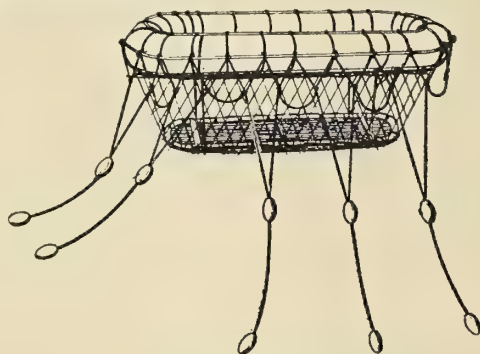
734,050. RAFT. JOSEPH G. ELDERKIN, FOX RIVER, CANADA.



Claim.—1. A timber raft made up of separate sections extending to the sides of the raft, section-binder cables surrounding each section and raft-binder cables surrounding all the sections and crossing the outer sides thereof, binding said sections together.

2. A timber raft made up of separate superposed sections extending from side to side of the raft, section-binder cables surrounding each section, and raft-binder cables surrounding all the sections and crossing the outer sides thereof. Five claims.

734,118. LIFERAFT. HORACE S. CARLEY, HYDE PARK, MASS., ASSIGNOR TO CARLEY LIFEFLOAT COMPANY, PHILADELPHIA, PA., A CORPORATION OF WEST VIRGINIA.



Claim.—1. In a collapsible reversible liferaft, a buoyant body of annular or similar continuous form, a bottom, a flexible part secured at one edge around the edge of the bottom, rings or eyelets arranged at suitable intervals along the other edge of said flexible part, flexible rings around the buoyant body passing through the eyelets on the flexible part, and draw ropes extending longitudinally along the buoyant body attached to the flexible rings and drawing the same tightly against the outer surface of said body but leaving them loose at the inner surface thereof, so that the eyelets or rings on the flexible part can run freely on the flexible rings. Four claims.

732,082. APPARATUS FOR CLEANING SHIPS' BOTTOMS. CHARLES JOHNSON, ST. GEORGE, CANADA.

Claim.—1. An apparatus for cleaning ships' bottoms, comprising a movable frame, rotary devices carried thereby for cleaning the bottom, a differential chain hoist adapted to be attached to the side of the vessel, a pulley mounted on the movable frame over which the chain of said hoist passes, a shaft on which said pulley is mounted, and means operatively connecting said pulley with said rotary cleaning devices. Five claims.